

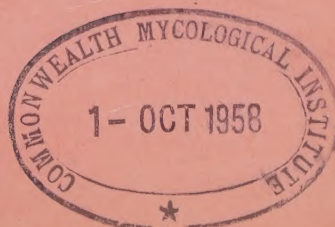
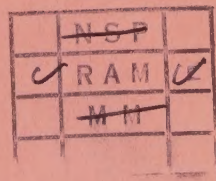


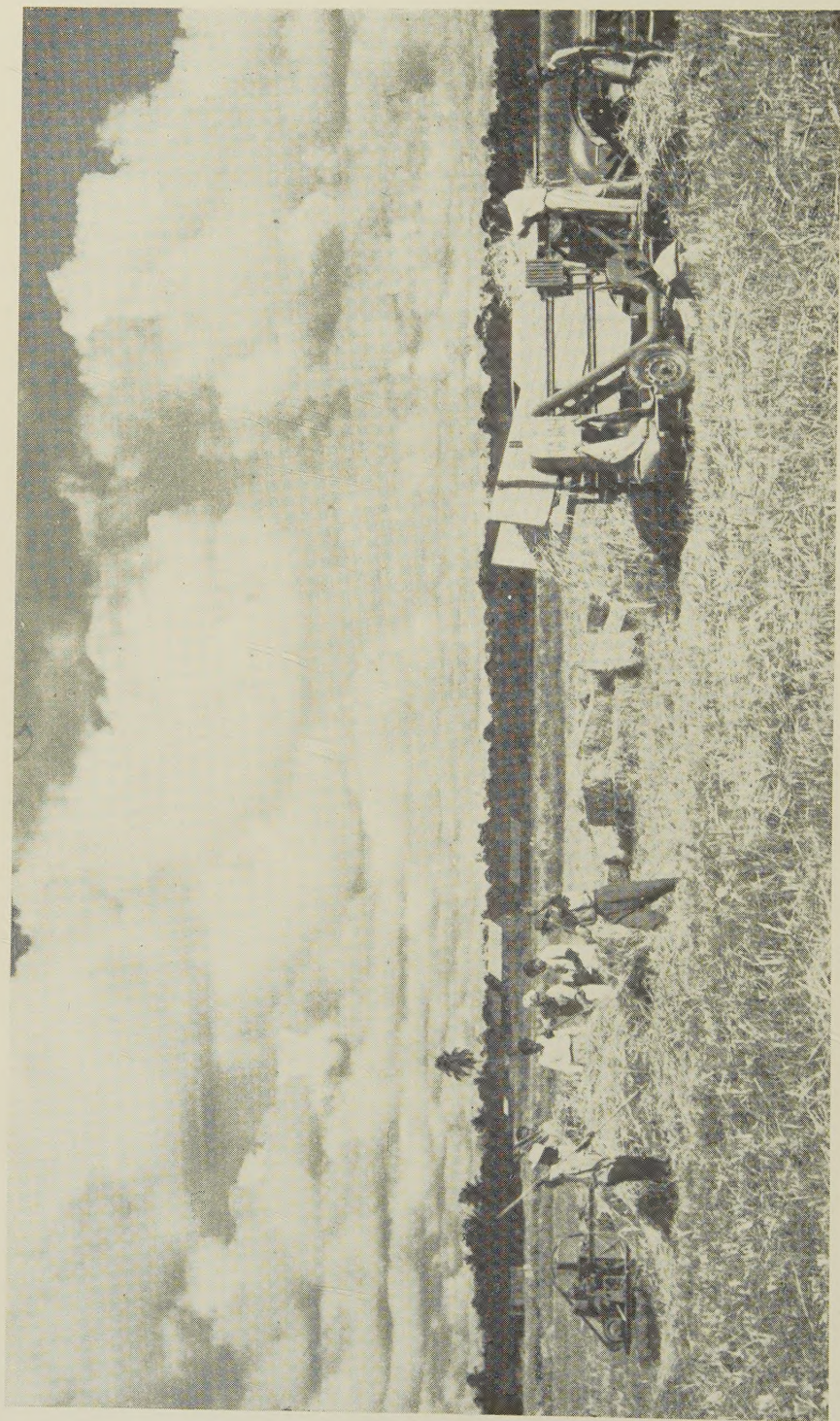
FEDERATION OF MALAYA

ANNUAL REPORT
of the
DEPARTMENT OF AGRICULTURE
for the year
1956

By
R. G. HEATH
*Director of Agriculture
Federation of Malaya*

Price: \$2.50





A course in baling of dry padi in progress at Paya Besar Padi Test Station, near Kuantan, Pahang.



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KUALA LUMPUR
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ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA, FOR THE YEAR 1956

SECTION I

POLICY AND PROGRESS

A.—POLICY

The agricultural policy of the Government was laid down in broad terms in the Alliance Platform for the Federal Elections. It is as follows:

1. Eventually to achieve self-sufficiency in essential food-stuffs;
2. (a) Increasing quantitatively and qualitatively existing agricultural produce and diversifying crops;
(b) Improving marketing systems;
(c) Giving financial assistance to agriculturists through the Land Bank and other agencies;
(d) Ensuring security to cultivators; and
(e) Providing agricultural education on as extensive a scale as possible.

The Department is concerned to a major degree with 1 and 2a and e above and to a lesser degree with the remaining items.

B.—ORGANISATION OF THE DEPARTMENT

2. As mentioned in the 1954 Report, the term "Department of Agriculture", in so far as the Federation of Malaya is concerned, embraces no less than 12 Departments—one Federal, two Settlement and nine State. Organisation on this basis is assisted by the fact that the Federation Agreement lays down that research is the function of the Federal Government and extension work that of the State and Settlement Governments. Administrative difficulties are not unknown, as is inevitable in an organisation of such nature, but experience has shown that provided close contact is maintained between the Headquarters staff of the Federal Department and the executive officers of the State and Settlement Governments, the majority of such difficulties can be overcome. The system demands of those officers of the Department who serve in the States and Settlements an *esprit de corps* of a high order and the ability, where necessary, to reconcile differing points of view in a manner not disadvantageous to the work of the Department as a whole.

C.—FINANCE

3. The coming into operation of the second Development Plan during the year resulted in the provision of considerable

additional funds for the research and investigation work of the Department, which had been operating at reduced tempo following the 1954 cuts in Federal expenditure.

D.—STAFF

4. At the beginning of 1956, the senior staff position was at its best since the early post-war years, with an approximate strength of 85 per cent on the ground compared with under 40 per cent during the period of lowest ebb, in 1952. During the year, however, the situation deteriorated; eight officers were lost as the result of transfers and retirements under phase 1 of the scheme for Malayanisation. The Pensions (Entitled Officers) Ordinance, 1956, while only three locally domiciled officers returned from overseas training to offset these losses. In addition, a further ten officers announced their intention of retiring under the Malayanisation scheme during the first half of 1957.

5. The situation as regards recruitment of Agricultural Assistants continued to improve and the position in this respect should be stabilised within the next two years.

E.—PROGRESS IN 1956

6. As mentioned in the 1955 Report, the achievements of a Department of Agriculture are normally appraised by the public, and rightly so, on the results of its extension programmes. The benefits accruing to the cultivators as the result of such work are the criteria of its importance. Nevertheless, it should not be overlooked that the basic soundness of any extension programme can only be determined by taking into account the results of planned and well-executed programmes of research and investigation. Without such results as a guide extension programmes may well be ill-conceived and doomed to failure with consequent loss of faith in the Department on the part of the cultivator. It is thus necessary to appreciate the value of research and investigation work in relation to extension programmes and to avoid the attitude of regarding such work as an investment of little value. Furthermore, it needs to be appreciated that for research and investigation work to be efficiently planned and carried out it should not be exposed to the vagaries of annual budgets. Much of this type of work is on a comparatively long term basis and requires the assurance, therefore, of financial support over a reasonable period if efforts are not to be dissipated and results jeopardised.

7. The main lines of Departmental activity during 1956 and the progress made are summarised as follows.

8. *Rubber*.—The Rubber Industry Smallholders' Planting Material Scheme came into force towards the end of the year. The Department is responsible, under this scheme, for the supply of approved planting material to all smallholders who wish to replant or new plant.

9. The Department, in conjunction with the Smallholders Advisory Service of the Rubber Research Institute, continued to

be responsible for assisting new planters with the problems of opening up and developing their lands. A scheme for the provision by Government of financial assistance to new planters was in process of drafting at the end of the year.

10. *Padi*.—The programme of improving varieties through selection and hybridisation was steadily maintained and extended. Mass distribution of improved varieties from the post-war programme of selection and breeding was undertaken in Malacca and in Negri Sembilan, where the work is most in advance; distribution in a number of other States will follow within the next year or two.

11. Fertiliser subsidy schemes were in operation in Kelantan, Negri Sembilan and Malacca. The Department remains in the position of being able to make specific recommendations for fertiliser application in the majority of the main padi growing areas, but price factors have affected the use of fertilisers in areas where the resulting increased yields provide only moderate compensation.

12. The field work of the economic survey of padi areas covering the Krian District of Perak, Province Wellesley, Kedah, Perlis and Kelantan was completed during the year and interpretation of the results was begun.

13. A pilot scheme for the mechanical cultivation of padi, on units of varying sizes, was inaugurated in the newly developed Trans-Perak Irrigation Area.

14. Excellent progress was made in the investigations concerned with the control of stem-borers, a major pest of the crop, and *penyakit merah*, its major disease.

15. *Coconut*.—Economic surveys, designed in the main to ascertain the extent of the need for replanting, were carried out in Johore and Kelantan and will be extended later to Perak and Selangor.

16. A new station for breeding work on the crop and agronomic trials was inaugurated in the Bagan Datoh area of Perak and a second station was opened near Muar for the study of the rehabilitation problems of holdings in the Johore coastal belt.

17. *Oil Palm*.—The co-operative scheme for breeding and selection work on this crop, involving the Department and the industry, came into being during the year.

18. *Pineapple*.—Considerable progress has been made in determining the agronomic requirements of pineapples, particularly with regard to the use of fertilisers and of hormones for controlling fruit production.

19. *Fruit*.—The output of budded fruit trees for distribution continues to increase and in some State and Settlements supply has overtaken demand.

20. *Cacao*.—Further progress was made in determining the agronomic requirements of this crop which has been recently introduced into Malaya. Two estates have been opened up and the first pilot scheme for smallholders was inaugurated in Trengganu.

21. *New Village Agriculture*.—As mentioned in the 1955 Report, the Department has played a considerable part in the stabilisation of the agriculture of the new village, with the result that the acreage of food crops other than padi is now well above the pre-Emergency level. By the selection of suitable areas of land, the provision of assistance for developing those areas, the supply of planting material and breeding stock—in all these ways, assistance has been given by the Department.

22. *Animal Husbandry*.—The setting-up during the year of a committee comprising officers of the two Departments concerned with animal husbandry problems, the Departments of Agriculture and Veterinary Services, has contributed greatly to the formulation of an integrated programme of work.

23. *Soil Surveys*.—The volume of soil survey work continued to increase, both for specific purpose, e.g., potential padi areas, cacao soils, etc., and in connection with the general soil survey of the country.

24. *College of Agriculture*.—The first of three Schools of Agriculture, which are designed to relieve the College of the responsibility for training at Certificate (One Year) Course level, commenced operations at Telok Chengai, Kedah, towards the end of the year.

F.—GENERAL

25. In concluding this section of the report, mention must again be made of the excellent work carried out during the year by the staff of all grades, in circumstances not always easy and at times difficult.

SECTION II

AGRICULTURE IN THE FEDERATION OF MALAYA

A.—WEATHER

26. Weather, in general, throughout the Federation was normal during the year with good dry seasonal weather for the 1955-56 padi harvest and well distributed rainfall during the main planting seasons.

27. Exceptions of course did occur, chiefly in the inland districts of Malacca and the eastern part of the Tampin district of Negri Sembilan which experienced very dry weather between April and October. At Alor Gajah in Malacca only 38.87 inches of rainfall were recorded during the year and the average from the inland districts was 44.44 inches as against an average of 89.97 inches on the coast.

28. In Johore the monsoon broke in the middle of November with great violence and caused widespread serious flooding, with loss of property and life on the East Coast. Elsewhere on the East Coast the monsoon was generally mild and lighter than usual, except for a very wet month in December.

29. As a result of very favourable weather in the main padi areas, the 1956-57 padi crop got away to an excellent start.

B.—CROP REPORTS

1. RUBBER

30. Comparative acreages under rubber in the Federation are as follows:

Calendar Year	Estates (Acres)	Smallholdings (Acres)*	Total (Acres)*
1951 ..	1,964,000 ..	1,500,000 ..	3,500,000
1952 ..	1,997,000 ..	1,500,000 ..	3,500,000
1953 ..	2,030,000 ..	1,500,000 ..	3,500,000
1954 ..	2,018,000 ..	1,500,000 ..	3,500,000
1955 ..	2,015,000 ..	1,500,000 ..	3,500,000
1956 ..	2,008,000 ..	1,500,000 ..	3,500,000

31. Production figures for the Federation are given in the following table:

Calendar Year	Estates (Tons)	Smallholdings (Tons)	Total (Tons)
1951 ..	328,000 ..	276,000 ..	604,000
1952 ..	341,000 ..	243,000 ..	584,000
1953 ..	341,000 ..	233,000 ..	574,000
1954 ..	346,000 ..	241,000 ..	587,000
1955 ..	353,000 ..	286,000 ..	639,000
1956 ..	353,000 ..	274,000 ..	627,000

32. The Pan-Malayan imports and exports of rubber were:

Calendar Year	Gross Exports (Tons)	Gross Imports (Tons)	Net Exports (Tons)
1951 ..	1,155,000 ..	347,000 ..	608,000
1952 ..	910,000 ..	339,000 ..	571,000
1953 ..	847,000 ..	278,000 ..	569,000
1954 ..	915,000 ..	344,000 ..	571,000
1955 ..	994,000 ..	362,000 ..	632,000
1956 ..	983,000 ..	366,000 ..	617,000

33. Rubber prices for R.S.S. 1 throughout the year have been generally good and averaged 104.88 cents per lb. during the first quarter, 85.75 cents per lb. and 94.83 cents per lb. during the second and third quarters and 103.25 cents per lb. during the fourth quarter. Overall average was 96.76, compared with 114.16 in 1955.

34. It will be noticed that overall production on estates did not increase during 1956—this was due partly to the loss of a further 3,000 acres and partly to the vigorous replanting programme being carried out by all the progressive companies.

* Estimates only, no accurate figures being available.

35. The figures for production from smallholdings are at the best only estimates. The lower production during 1956 was due partly to the drop in prices and partly to replanting. The 1956 production, however, exceeded the 1954 figure by 33,000 tons.

36. Rubber in Malaya is generally marketed in the form of Ribbed Smoked Sheet (R.S.S.), Crepe and Preserved Latex. Small quantities of specialised types such as Rubber Powder and Cyclised Rubber are also produced. Approximately 62.5 per cent of the rubber in the Federation is marketed in the form of Ribbed Smoked Sheet, 23.5 per cent as crepes of various types and 14 per cent preserved latex.

37. Latex marketing schemes, introduced with the dual purpose of improving the quality of the rubber produced by smallholders and of increasing the value to the smallholder of his crop, have unfortunately not in practice fulfilled their early promise and have with few exceptions made little or no headway in the last year, with some centres closing down.

38. In the report of the International Bank Mission, the views of the Mission of Enquiry into the Rubber Industry of Malaya (the Mudie Report) on the importance and urgency of enlarging the area planted to high-yielding rubber received full support, likewise the recommendation that the replanting scheme for smallholders be continued and extended and that a Government-sponsored programme of estate replanting be instituted.

39. In the White Paper on Taxation and Replanting in the Rubber Industry presented to the Government in 1955, the Government adopted proposals to assist the rubber planting industry in its replanting and new planting programmes. The cost to the Government is expected to be some \$280 million, \$112 million of which is to go to the smallholders' section of the industry. During the year a pool of rubber planting material was set up; this took over the past work of producing planting material from the Rubber Industry (Replanting) Board, Fund B and at the same time undertook to supply the planting material needs of smallholders newly joining the rubber industry.

40. A second scheme financed from the \$112 million was launched under the auspices of the Rubber Industry (Replanting) Board, whereby any smallholder with five acres or less who owns both land not yet planted and old rubber land can new-plant on one area to the equivalent acreage of his present rubber holding and, when the new trees come into bearing, he must cut out and replant his old holding. He is allowed a grant of \$500 per acre to assist in his new planting.

41. A third scheme for new planting is in the advanced planning stage and will probably come into operation in 1957.

42. Smallholding interests are the concern of the Administrators of Fund B of the Rubber Replanting Scheme, under

whose direction the Smallholders' Replanting Organisation functions. The aim is to replant a total of 500,000 acres of small-holding rubber in six years from the date of the Scheme's inception, i.e., 1952. Of necessity, having regard to the need for staff recruitment and training as well as for publicity in the early stages, the annual target for replanting was graded, commencing with 40,000 acres in the first year and ending with 90,000 acres in the final year. The whole undertaking is a most formidable one and there are few, if any, schemes elsewhere in tropical agriculture of equal magnitude and importance.

43. The replanting target for 1956 was 70,000 acres and again was not reached. Of 17,604 applicants who wished to replant rubber on 79,789 acres, only 14,180 with 59,336 acres fulfilled the stipulated conditions and received the necessary approval. By the end of December 11,393 of the approved applicants, with a total of 36,843 acres, had received the first cash grant which is payable when felling, clearing, lining and holing are completed and authority given to commence planting. This figure is an improvement on the 1955 figures of 8,116 approved applicants and 25,932 acres.

44. When conditions are suitable, encouragement is given to replant with crops other than rubber, the same scale of grant as in the case of rubber being paid. This policy resulted in 1956 in 1,835 smallholders (5,134 acres) applying to plant with other crops. Out of these, 1,241 applicants with 3,656 acres were accepted, as compared with 1,721 applicants (4,922 acres) in 1955.

45. From the date of commencement of the scheme, 116,877 acres have been replanted with high yielding rubber and 10,714 acres with approved alternative crops. The latter comprised: fruit, 2,849 acres; coconuts, 2,925 acres; coffee, 1,899 acres; padi, 1,332 acres; pineapples, 1,362 acres; and sago, 346 acres. In addition, 7,216 acres were replanted with rubber and 331 acres with crops other than rubber as excess replanting and not qualifying for a grant, giving a total area of 135,140 acres replanted since the inception of the scheme. Up till the end of 1956 the approximate total financial outlay under Schemes 1 and 2 of Fund B amounted to \$32,800,000.

46. A high standard of maintenance in replanted holdings is exacted and cash grants may be withheld if maintenance is found to be sub-standard. In regard to lalang (*Imperata cylindrica*) in particular, full and complete eradication is demanded on the grounds that once it becomes firmly established, not only will the replanted rubber be several years late in coming into bearing but yields may be permanently impaired and the advantage accruing from the use of high yielding material very greatly reduced.

47. The progress of the schemes can be judged by the number of deferments of second and higher payments. Out of a total of 25,772 first grants paid, there have been, so far, 10,504 deferments (40.7 per cent). Of these, Malaysians easily top the list with 8,101 deferments (77 per cent of total deferments), the

Chinese are second with 2,200 deferments (21 per cent) and there have been 203 deferments (2 per cent) for smallholders of other races.

48. In 1956, the total grant payable to smallholders was again raised from \$500 to \$600 per acre, \$100 of which being a grant from the \$112 million referred to previously, but even this additional incentive has proved insufficient to offset the full effects of the relatively high price of rubber, which, of course, discourages replanting, and the numerous difficulties smallholders have to overcome in replanting their holdings.

49. New planting of rubber continued at an increased rate, principally in Kedah, Kelantan, Trengganu, Perak and Penang.

50. In Kedah, Perlis and Johore there has been considerable illegal planting of smallholdings in recent years, the total area being estimated to amount to approximately 250,000 acres. Unfortunately the bulk of this planting has been with ordinary unselected seedlings. This is a serious state of affairs, as it means that Malaya is losing much of its potential crop and is thus placed in a less favourable position to meet any severe outside competition. In addition, the unauthorised smallholder is developing an uneconomic holding and will not be able to face lower prices.

51. Practically all States report numerous applications for new planting as the result of good prices for rubber and the easing of the Emergency. While there are bound to be delays before actual planting takes place, there is little doubt that the next few years will see a considerable increase in the acreage under rubber. In Johore, Kedah, Kelantan and Pahang, where most of the new planting occurs, active steps are being taken to organise new planting and to ensure that only high yielding seedlings are planted. This is being encouraged by the recently formed Federal Land Development Authority.

52. The current prices of 25 cents per yard and 15 cents per seedling charged to the smallholder for budwood and clonal seedlings remained in force throughout the year. These prices were equated to commercial costs, and on an acreage basis the cost is approximately \$30 for either clonal seedlings or buddings, including budgrafting. Rising labour costs have however made these figures uneconomic and prices will have to be raised in 1957.

53. In order to protect the interests of the country, it was necessary in October to impose a ban on the export of Tjir. 1 clonal seed from Malaya. During past years a very considerable trade in the export of clonal seed from Malaya has been built up by certain agency firms; this trade had developed so much that there was a grave danger of not obtaining sufficient seed for the needs of the smallholders.

2. RICE

54. The 1955-56 season saw a decrease of some 18,000 acres in the acreage planted with wet padi. This decrease was due partly to adverse weather conditions in the main padi areas of

the north and partly to the usual lack of interest in padi planting outside the main areas as a result of an increase in rubber prices. The area under dry padi however increased slightly, mainly due to new areas being developed for rubber.

55. It is of interest to note that although the total acreage was lower and weather conditions were far from favourable, production of both wet and dry padi was greater than the 1954-55 season by 15,100 tons. This is a sure indication that the industry is slowly being placed on a surer footing and becoming more efficient.

56. Estimates of the acreage planted in the 1956-57 season show an increase of approximately 11,000 acres, again reflecting the upward trend of interest in padi following a fall in rubber prices. The 1956-57 padi season has been extremely favourable and a record crop is expected to be harvested. The following table gives comparative figures for acreage under wet and dry padi together with yields since 1950:

Season	Wet Padi		Dry Padi		Total Padi	
	Acreage (Planted)	Yield (Tons)	Acreage (Planted)	Yield (Tons)	Acreage (Planted)	Yield (Tons)
1950-51 ..	829,000	685,000	.. 47,000	18,000	.. 875,000	703,000
1951-52 ..	790,000	526,000	.. 41,000	16,000	.. 831,000	542,000
1952-53 ..	790,000	684,000	.. 44,000	16,000	.. 834,000	700,000
1953-54 ..	809,000	635,000	.. 37,000	13,000	.. 846,000	648,000
1954-55 ..	843,000	633,000	.. 48,000	19,000	.. 891,000	652,000
1955-56 ..	825,000	644,100	.. 51,000	23,000	.. 876,000	667,100

57. A total area of 9,010 acres was double cropped with wet padi during 1956. This is a very considerable improvement over the 1955 figure of 6,361 acres and is more in line with the 1954 figure of 9,254 acres. The average yield in 1955 was 341 gantangs* (gtg.) per acre as compared with 239 gantangs in 1955. The corresponding figure for 1954 was 309 gantangs. Double cropping has been practised in the Sungei Dua area of Province Wellesley since the time of the Japanese occupation of Malaya and is rapidly gaining in popularity.

58. Dry padi in this country is grown under two entirely different sets of conditions, either in the semi-wet, as in Kelantan and Trengganu (*padi tugalan*, *padi taboran* or *padi tenggala*) or as hill padi now classified as upland dry padi.

59. There is no doubt that, when weather permits, padi is being grown more and more efficiently, but the yield increases per unit area do no more than keep pace with the additional requirements of a steadily growing population. The ratio therefore of production to consumption has varied very little since the war.

60. The acreage under *padi tugalan*, now known as lowland dry padi, also varies considerably depending mainly on weather conditions and the ease with which the padi fields can be cultivated.

* 1 gantang = 1 imperial gallon or 5.6 lb. padi.

61. Since the middle of 1956 more accurate statistics have been kept of the two types of dry padi. The relative figures for the 1956-57 season are: Upland dry padi, 12,500 acres; and lowland dry padi, 41,800 acres. It is of considerable interest to note that the average yield of padi in the Federation is the highest in the South-East Asian countries (excluding Japan, which is outside the tropical belt) and the following table clearly indicates the good progress that is being made:

Country	Type of Rice	Average Yield per Acre				Percentage Increase of B over A
		Period A		Period B		
		1945-46 to 1949-50		1950-51 to 1953-54		
		Lb.	Gtg.	Lb.	Gtg.	
Malaya ..	<i>Indica</i> ..	1,362	248	1,708	311	+25%
Indonesia ..	" ..	1,281	233	1,409	256	+10%
Burma ..	" ..	1,414	257	1,393	253	-1.5%
Pakistan ..	" ..	1,245	226	1,214	221	-3%
Thailand ..	" ..	1,173	213	1,182	215	—
Ceylon ..	" ..	1,053	191	1,150	209	+6%
India ..	" ..	1,063	193	1,119	203	+5%
Philippines ..	" ..	992	180	1,045	190	+5%
Indochina ..	" ..	987	179	1,005	183	+2%

(Source of information: *International Rice Year Book, 1955*)

62. The Department of Agriculture can claim to be responsible for much of this 25 per cent increase through its efforts in selection and distribution of high yielding varieties, the initiation of more efficient pest and disease control measures and work on the manurial requirements of padi.

63. Production, with the exception of the padi grown at Changkat Jong, Perak, and a part of Tanjong Karang, Selangor, is mainly in the hands of the Malays, while milling and marketing are almost entirely a Chinese monopoly. The average price of imported Siam rice (new crop) in 1956 was about \$1 per pikul lower than in 1955. The Government guaranteed minimum or support price for locally grown padi was raised from 10½ cents per lb. to 11 cents for the 1956-57 season. The easing of tension in international rice affairs and the existence of substantial rice stocks surplus to world requirements are not accepted as grounds for reducing output in Malaya, and intensification of local production by opening up potential new areas and improving existing areas, by the extended use of high yielding strains and fertilisers and by the introduction of improved field techniques still remains the policy of the Government.

64. Under Malayan conditions, padi suffers comparatively little from diseases, an unidentified complex known as *penyakit merah* being probably the most important. This was very much in evidence during the 1954-55 season and resulted in serious loss of crop in certain areas. Pests, on the other hand, particularly stem-borers and to a less extent rats, cause great damage to crops annually and there is considerable scope for the extension of organised pest control measures.

65. A subsidised fertiliser scheme was in operation in Kelantan for the fifth year in succession, and a new scheme has

been inaugurated which guarantees the subsidy over a period of four years. The subsidy for 1956 was 33.6 per cent (\$4.30 per 100 lb. bag). This resulted in 18,308 bags being sold to the end of December, 1956, as compared with 19,967 in 1955, 6,626 bags in 1954 and 16,113 bags in 1953. If all farmers in the State applied manure once in three years, approximately 95,500 bags would be required annually. In addition to the quantity distributed under the scheme a further 1,973 bags were sold by a non-participating firm at the full (unsubsidised) market price.

66. In Trengganu the scheme which was started in the 1955-56 season was discontinued. However, in spite of there being no subsidy the farmers purchased no less than 2,242 bags of fertiliser compared with 1,052 bags during the 1955-56 season and 1,096 bags in the 1954-55 season, when in both the latter years a subsidy was available.

67. In Malacca the subsidy was reduced from \$15 per acre to \$10 per acre and the necessity of collecting \$10 per acre from cultivators before distribution resulted in considerably less demand during the 1956-57 season, and only 4,618 bags were sold as compared with 9,482 in the previous season. The 4,618 bags of fertiliser are sufficient for only about 1,150 acres of the 30,400 acres planted in the Settlement. As the fertiliser was given on credit in the 1955-56 season, it is known that many farmers accepted it because there was nothing to pay at the time. Nearly half the manure issued in 1955 has yet to be paid for and it is likely that many bad debts will occur.

68. In Negri Sembilan a scheme was launched with half the cost of the fertiliser being subsidised. The demand was rather disappointing, probably due to lack of ready cash (no credit being allowed), failure of the agents to push their wares and the natural prejudice of the padi planters against new methods. However, approximately 2,400 bags were sold, sufficient to treat 600 acres.

69. All these schemes were made possible by the grant of \$10 million from the Federal Government to assist padi planters.

70. In Kedah and Perlis the usual fertiliser is bat guano and large quantities of it are used annually. Rock phosphate is slowly gaining in popularity in Penang, Province Wellesley and in parts of Perak and bone meal is used in Malacca at transplanting time.

71. On the whole there is therefore little doubt that padi cultivators are slowly becoming manure-conscious.

72. Post-war botanical research and agronomic investigations have progressed sufficiently far to permit the extensive demonstration on farmers' land of new padi selections and improved strains as well as improved techniques of planting and the use of fertilisers. Selected padi varieties are now being issued on a commercial scale in Malacca and Negri Sembilan.

73. Soil sampling of the Kedah Plain to determine its fertiliser requirements was taken a stage further in 1956 and will be completed early in 1957.

74. The problems of rice mechanisation up to the stage of planting have largely been solved, but those relating to planting and harvesting still present difficulties. The pilot scheme in the Trans-Perak area made a reasonably good start.

75. Data in regard to annual Pan-Malayan retained imports of rice and costs are given in the following table:

NEW IMPORTS OF RICE

(Pan-Malayan)

Year		Tons		Value in \$
1951	..	499,000	..	218,740,000
1952	..	423,000	..	198,886,000
1953	..	494,000	..	271,079,000
1954	..	268,000	..	124,812,000
1955	..	484,000	..	164,031,000
1956	..	503,000	..	179,307,000

76. The Rice Committee completed its work in September, 1956, and made 34 recommendations for measures to assure an economic return to the padi cultivator. The report was still under consideration by Government at the end of the year.

3. OIL PALM

77. Oil palm cultivation in Malaya is confined wholly to estates, but with organised central processing it could equally well become a smallholders' crop.

78. Details of acreages planted and the production of oil and kernels are as follows:

Year		Planted Acreage		Palm Oil (Tons)		Palm Kernels (Tons)
1951	..	97,000	..	48,000	..	12,000
1952	..	100,000	..	45,000	..	11,000
1953	..	108,000	..	49,000	..	13,000
1954	..	109,000	..	54,000	..	14,000
1955	..	111,000	..	56,000	..	15,000
1956	..	115,000	..	56,000	..	14,000

79. The London-quoted average price for palm oil for 1956 was £83.46 per ton, £8.07 per ton higher than the average 1955 price.

80. During the year agreement was reached between the United Planting Association of Malaya and Government to pool all research work on this crop. Both commercial estates and the Department of Agriculture have had a number of scientists working on oil palm problems and carrying out selection work. Pooling of information should result in a considerable speeding up of this work and the avoidance of much duplication. A joint meeting of the Council was held during the year.

4. COCONUT

81. The coconut comes next in importance to rice and rubber as a smallholders' crop: only 20 per cent of the estimated total acreage of 530,000 is estate-planted. The acreage under smallholdings is difficult to estimate accurately but provisional figures for 1956 indicate little change, with yields much the same as in

1955. The coastal alluvial clays have proved eminently suitable for coconut growing and, where drainage and general husbandry are of a high standard, average yields of up to 1,600 lb. of copra per acre are not uncommon.

PRODUCTION (TONS)

Federation of Malaya

Year	COPRA		COCONUT OIL	COPRA CAKE
	Estates	Smallholdings		
1951 ..	39,000	121,000	86,000	56,000
1952 ..	40,000	115,000	81,000	52,000
1953 ..	40,000	112,000	79,000	50,000
1954 ..	40,000	124,000	97,000	62,000
1955 ..	40,000	104,000	95,000	60,000
1956 ..	39,000	115,000	108,000	68,000

82. At the end of 1956 there were some 95 estates in the Federation with a total of about 93,000 acres. These estates range in size from 100 to over 3,000 acres.

83. Since the war, owing to shortage of local supplies, oil millers have built up a considerable trade of importing copra from neighbouring territories. This has resulted in the Pan-Malayan trade figures showing an adverse trade balance, with gross imports of copra exceeding gross exports, as shown in the following table:

NET IMPORTS OF COPRA

Year	Tons		Value \$
1951 ..	11,000	..	6,606,000
1952 ..	28,000	..	4,501,000
1953 ..	10,000	..	2,085,000
1954 ..	67,000	..	23,446,000
1955 ..	75,000	..	24,446,000
1956 ..	83,000	..	29,051,000

84. The coconut oil industry, however, has expanded steadily and net exports have risen as follows:

NET EXPORTS OF COCONUT OIL

Year	Tons		Value \$
1951 ..	68,000	..	87,508,000
1952 ..	65,000	..	53,966,000
1953 ..	61,000	..	58,033,000
1954 ..	79,000	..	74,719,000
1955 ..	91,000	..	67,554,000
1956 ..	103,000	..	73,318,000

85. Coconuts are planted in both pure and mixed stands, and while the production of copra for export or for local extraction of oil is the main market interest, nevertheless there is a very considerable trade in fresh nuts for home consumption. Estate-produced copra, the result of a carefully controlled process, is of high quality and generally commands a good price. Smallholding copra, on the other hand, is often of poor quality owing to lack of care and attention. But, because of a prevailing sellers' market,

the disposal of copra—regardless of the quality—has been a comparatively easy matter and the incentive therefore to improve quality and to grade before marketing scarcely exists.

86. The main coconut areas in the Federation are the west coastal area of Johore, the Bagan Datoh peninsula in Perak and the coastal area of Province Wellesley. Coconuts are also extensively grown along the East Coast.

87. Extensive drainage work on the western coast of Johore continues and the prospects of the smallholders in that area are slowly improving. Elsewhere, the industry appears to be static, with perhaps a slight tendency to a decline in yield due to the old age of the palms and a lack of any organised replanting.

88. During the year a Working Committee was set up to collect and review existing agricultural and economic data on the coconut industry and make recommendations for the improvement and development of the industry. A preliminary report has been issued which indicates the need for properly conducted surveys.

89. Surveys were carried out by the Department of Agriculture in Johore and Kelantan during the year but the final reports were not ready by the end of the year.

90. The Rhinoceros Beetle, *Oryctes rhinoceros*, is Malaya's worst potential coconut pest whose incidence, despite widespread propaganda, appears to be increasing. This is explained by the fact that the beetle has been found to breed extensively in felled rubber, and with rubber replanting now being conducted on such an extensive scale it is difficult to exercise the required amount of control to deny this breeding ground to the beetle.

5. PINEAPPLES

91. Pineapples are grown throughout Malaya, but in only three States are they cultivated for canning. In the post-war rehabilitation of the industry, emphasis has been laid on permanent plantations in contrast to the catch-crop system of before the war. That a crop of such economic importance as the pineapple can be successfully grown on deep peat is indeed a fortunate coincidence and current policy therefore is to restrict sole cropping to the peat areas, of which there are large reserves.

92. The area under pineapple on both estates and smallholdings is steadily increasing, for both canning purposes and the fresh fruit trade. Large-scale clearing of jungle, extensive drainage works and planting were in progress in Johore and to a lesser extent in Selangor and Perak.

93. The total acreages under cultivation during the past four years were as follows:

1953		1954		1955		1956
23,930	..	27,950	..	34,850	..	44,780

94. Out of these totals the acreages devoted to pineapples being grown for the canneries are:

	1953		1954		1955		1956
Estates ..	8,656	..	8,976	..	13,876	..	19,062
Smallholders ..	10,499	..	12,106	..	16,499	..	18,974

95. Johore has by far the largest producing area with Selangor next and then Perak.

96. The industry, through the Pineapple Joint Industrial Council, finances the annual programme of experiments which is pursued at the Pineapple Stations in Johore and Selangor by the Department of Agriculture.

97. A total of 274.1 million lb. of fruit was received by the canneries during the year, as compared with 175.3 million lb. in 1955. Out of this figure, smallholders produced 114.4 million lb. and estates 159.7 million lb. Johore production totalled 253.4 million lb., Selangor 14.0 million lb. and Perak 6.7 million lb.

98. Improved husbandry is playing a very important part in improving yields and of raising the standard of the industry. This is most essential if Malayan pineapples are to hold their place in world markets and compete with the ever-growing competition from other countries.

99. Exports of canned pineapples from the Federation amounted to 22,275 tons in 1956 as compared with 20,121 tons in 1955 and 16,236 tons in 1954.

100. The industry faced a major crisis towards the end of the year, as the result of very poor sales of canned pines to the United Kingdom due to the cold, wet summer. This resulted in large stocks of canned pines having to be held at local canneries and a general reluctance to continue production at the normal rate. In order to try to clear stocks, prices were reduced and this automatically involved the growers. After much disagreement a temporary solution was found, with the growers accepting the following prices:

3.2 cents per lb. for Johore and Singapore

3.75 cents per lb. for Selangor and Perak

101. In addition to these production and marketing problems the canneries in Johore were also faced with considerable labour unrest and many strikes occurred.

6. CACAO

102. Observation plots of Amelonado cacao established in all States and Settlements of the Federation continued to yield valuable information which, when studied in conjunction with the results from precise experimentation, has gone a long way towards improving the knowledge in regard to husbandry techniques under Malayan conditions. The prospect of cacao as a potential economic crop for Malaya are good, especially on the better types of soil in Pahang and Trengganu, and the progress so far achieved has been followed with interest in the country. Both Trengganu and Pahang have earmarked blocks of State land for future development with cacao in pursuance of their land utilisation policy.

103. The recommendation made by the Cacao Working Party that, in addition to development of the industry by estates, smallholders should likewise be encouraged to grow the crop but that the development of a smallholding industry should be through a series of pilot schemes was put into practice when the first pilot scheme at Jerangau in Trengganu was started during the year.

104. This pilot scheme got away to a good start and 18 acres out of the 48 acres to be planted with cacao were planted. The 12 smallholders proved to be keen and industrious, and further pilot schemes are under consideration in Pahang.

105. Commercial planting of Amelonado cacao, begun first of all in 1953 on an estate in Trengganu, was continued and at the end of 1956, 525 acres had been established on that estate. A second estate nearby is also being developed and 124 acres were planted in 1956.

106. Tree shrews, rats and squirrels have all been troublesome, even on small, well-protected holdings, and it remains to be seen, once extensive planting is undertaken, whether or not pest control will prove excessively costly. The present indications are that it will not be so.

7. TEA

107. Both lowland and highland teas are grown commercially in Malaya and although the former may be of poorer quality its greater yield per acre, almost double that for highland tea, more than offsets the disadvantages of a slightly lower market price, and in addition it commands a ready sale on the London market. On well-managed highland estates, crops of 800 lb. of made tea per acre are obtained. Tea is not exclusively an estate crop but smallholders appear not to be particularly interested and yields are low in comparison with estates. Clean weeding, despite publicity with regard to erosion dangers, is still practised by some growers.

108. Tea prices in 1956 have remained at a high level, causing the crop, temporarily at least, to be one of the most profitable to grow. Two lowland estates continued to extend their planted acreages. High grades of highland tea were sold at about six shillings (\$2.57) per lb. on the London market while the local price for a somewhat lower grade was about \$1.50 per lb.

109. In the highlands, the anticipated increased incidence of Blister Blight (*Exobasidium vexans*) during the wet months of November and December was effectively controlled by the use of copper fungicides. This disease although recorded from the lowlands does little serious damage there.

110. Production figures of dried tea are as follows:

Year		Production (lb.)		Exports of Local Tea* (lb.)
1951	..	3,684,000	..	1,679,000
1952	..	2,785,000	..	1,752,000
1953	..	4,187,000	..	2,172,000
1954	..	4,590,000	..	2,757,000
1955	..	5,306,000	..	2,864,000
1956	..	5,023,000	..	3,633,000

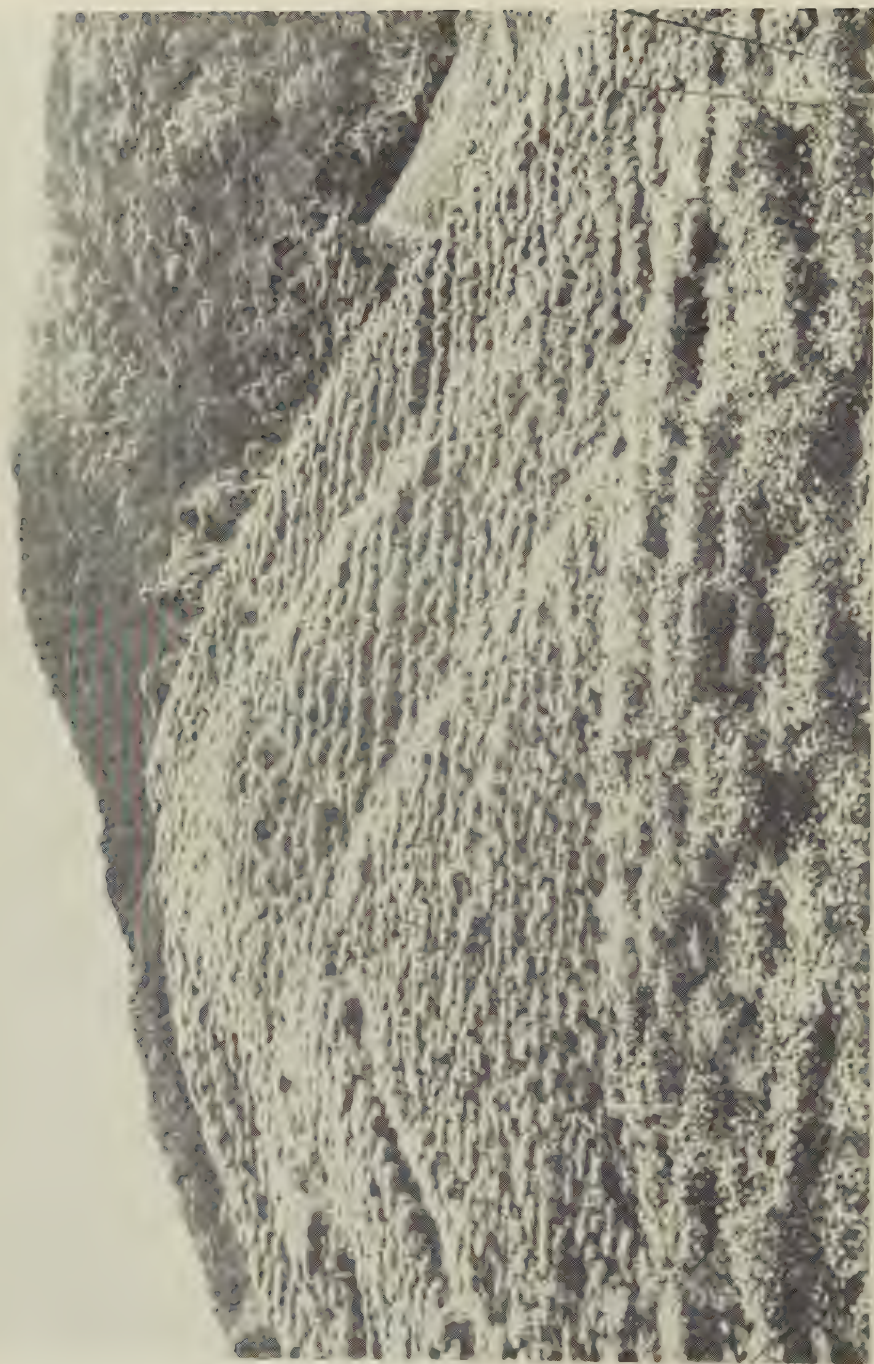
8. FOOD CROPS, VEGETABLES AND FRUITS

111. The acreage under food crops increased from 96,900 acres at the end of 1955 to 101,700 acres at the end of 1956. The

* In addition to these quantities, a small amount of Malayan tea is mixed with foreign teas and then exported.



Clonal rambutans in a variety trial at the Federal Experiment Station, Serdang.



Highland tea cultivation at the Federal Experiment Station, Cameron Highlands. The white posts in the diagram
denote the posts in a natural system.

main rice substitute crops were sweet potatoes, tapioca and yams. Tapioca was also extensively grown for the production of starch. During the annual fallow it is customary in the East Coast States of Kelantan and Trengganu and in Kedah, Penang, Selangor and Malacca to cultivate small selected areas of the rice fields with crops such as groundnuts, maize, beans, chilli, cucumber and lobak.

112. The considerable area of intensively cultivated market gardens which exists mainly for the production of leafy vegetables—chiefly lettuce and mustard—was maintained. In Cameron Highlands about 1,200 acres were under vegetables.

113. Water melons continued to be an important seasonal crop in the northern States experiencing monsoon conditions.

114. Bananas were again favoured as a catch-crop in newly-planted and replanted rubber, the planted acreage showing an increase of 4,000 acres over that of 1955.

115. Fruit trees in mixed stand are a feature of every kampong* and the total area throughout the Federation is estimated at 96,000 acres, an increase of 3,000 acres over 1955. Much of this increase is due to the conversion of old rubber lands to fruit under the rubber replanting scheme and interest in the production of mandarin oranges. The Department of Agriculture's selected fruit clones are popular and the distribution of large quantities of improved planting material was an important Departmental undertaking.

116. The fruit harvest was generally poor and in some areas almost a complete failure. Weather conditions probably accounted for this.

9. MANILA HEMP

117. On the experimental evidence so far available, the variety Tangongon would appear to be the best suited to Malayan conditions. Although satisfactory yields have been obtained on some volcanic soils and on well-drained alluvial clays and quality is good, interest in this crop has declined.

10. RAMIE

118. Cultivation is virtually confined to experimental planting. Trials have shown that this crop requires a high standard of cultivation and heavy manuring on most Malayan soils.

11. COFFEE

119. Coffee is essentially a smallholders' crop in Malaya, there being only one estate, and present production is insufficient to meet local requirements. The price for Liberica coffee, which is the only planted variety of importance, stood at \$180 to \$210 per pikul at the beginning of the year but slumped to \$125 to \$135 per pikul when the mid-year crop came onto the market. Later on, prices strengthened to \$140 per pikul (£273 per ton), at which price gross returns per acre average about \$780 (£91). Despite the lower prices, interest in this crop was well maintained and the planted area increased in 1956 to 13,000 acres.

* Kampong = Village.

12. SPICES

120. Only arecanuts and pepper are of importance as export crops. Other spices such as chillies, ginger, turmeric, sireh, nutmegs and cloves are all cultivated on a small scale and largely for the internal market.

13. TOBACCO

121. Tobacco is an important cash crop usually grown in rotation with market garden vegetables or as an off-season crop in padi areas. Although the leaf is coarse in quality it meets with a ready sale for the manufacture of cut tobacco and cheroots. The area planted was estimated at 4,000 acres.

122. The imposition of a tax on locally produced manufactured and leaf tobacco not only caused much dissatisfaction amongst the growers and manufacturers but also resulted in a very considerable drop in the acreage planted.

14. MISCELLANEOUS CROPS

123. Other crops of minor importance which are grown are derris, gambier, kapok, ipecacuanha, patchouli, citronella, sugar palm, nipa palm, sago, groundnuts, maize, yams and pulses.

C.—STOCK

124. Livestock, an important capital asset in smallholding agriculture, are raised and maintained with the minimum of trouble to the owner. Mixed farming in the generally accepted sense is little practised. In the main padi-growing States, buffaloes and cattle are primarily used as draught animals, the production of meat and milk being of secondary importance. In certain States extensive areas are set aside as communal grazing grounds, but for the most part they are infrequently used and are not well maintained. Seldom, if ever, are concentrates fed. Milk production on a small scale is conducted by Indians near the larger towns.

125. Sheep are found in the drier east coast areas though not in large numbers. Goats are kept in most areas.

126. The prices of pig feeding stuffs remained high with the result that the average price of pork fell but little despite the continued increase in the pig population. The use of Middle White boars for crossing with the local sows is now a well-established practice in all the major pig-rearing areas. A total of 139,600 pigs were slaughtered at the Kuala Lumpur abattoir as compared with 114,777 in 1955.

127. A considerable trade continued in poultry and eggs. There were large numbers of small-scale poultry rearers both in rural and urban areas whose needs in the way of breeding stock and eggs for hatching were met mainly by the commercial poultry farms. These commercial poultry farms are highly organised units which rear both local and imported breeds. The Rhode Island Red and White Leghorn remain the most popular of the imported breeds. Interest in the imported breeds continued to wane during the year, except in urban areas.

128. In the urban areas a number of specialised farms are developing with birds being kept under battery and deep-litter systems.

TABLE I
DEPARTMENT OF AGRICULTURE, 1956
Organisation and Establishment by Branches (Excluding Clerical and Non-Technical Minor Posts)

DIRECTOR					
DEPUTY DIRECTOR					
RESEARCH BRANCH	AGRONOMY BRANCH	FIELD BRANCH	PUBLICATIONS BRANCH	EDUCATION BRANCH	ADMINISTRATION BRANCH
1 Assistant Director (Research) 5 Heads of Divisions: 2 Senior Research Officers, Grade A 3 Senior Research Officers, Grade B	1 Senior Agronomist	1 Assistant Director (Field) 1 Personal Assistant 5 Senior Agricultural Officers, Grade A 1 Senior Agricultural Officer, Grade B 11 Agricultural Officers 1 Agricultural Economist	1 Publications Officer	1 Principal College of Agriculture 2 Senior Lecturers 1 Registrar and Bursar	1 Administrative Officer 1 Office Assistant 1 Financial Assistant
14 Other Senior Officers 5 Senior Officers (<i>Leave Reserve</i>) 1 Assistant Chemist 19 Agricultural Assistant Service Scheme Posts 36 Junior Agricultural Assistant Service Scheme Posts 21 Miscellaneous Junior Technical Posts	13 Other Senior Officers 5 Senior Officers Other than Professional 1 Assistant Statistician 15 Agricultural Assistant Service Scheme Posts 27 Junior Agricultural Assistant Service Scheme Posts 8 Miscellaneous Junior Technical Posts	7 Senior Officers (<i>Leave Reserve</i>) 104 Agricultural Assistant Service Scheme Posts 187 Junior Agricultural Assistant Service Scheme Posts	3 Miscellaneous Junior Technical Posts	9 Agricultural Assistant Service Scheme Posts 2 Miscellaneous Junior Posts	3 Posts
102 Posts	70 Posts	318 Posts	4 Posts	15 Posts	

SECTION III

THE DEPARTMENT OF AGRICULTURE ESTABLISHMENT AND STAFF

A.—ESTABLISHMENT

129. The establishment of the Department is shown at Table I. The number of posts for senior professional officers remained at 70, which includes 12 leave-reserve posts, all of which were vacant. Of establishment posts, there were eight vacancies at the close of the year, made up as follows:

Senior Entomologist	...	...	...	...	1
Entomologist	...	...	...	...	1
Botanist	...	...	...	...	1
Soils Chemist	...	...	...	...	1
Chemist	...	...	...	...	1
Statistician	...	...	...	...	1
Senior Lecturer	...	...	...	...	1
Agricultural Engineer	...	...	...	...	1

B.—SENIOR STAFF CHANGES

1. BRANCH-HEAD POSTS

(i) *Head Office (Administration).*

130. Dr. C. C. Webster, Deputy Director of Agriculture, was appointed to act as Director of Agriculture with effect from the 14th March, 1956, and continued to carry out those duties until the 13th September, 1956.

(ii) *Field Branch.*

131. Mr. J. Cook, Assistant Director of Agriculture (Field), acted as Deputy Director of Agriculture until the 13th January, 1956, when he proceeded to Sarawak on promotion to the post of Director of Agriculture there. Mr. H. J. Simpson, P.J.K., Assistant Director of Agriculture (Field), acted as Deputy Director of Agriculture from the 14th March, 1956, until the 13th September, 1956, and again from the 7th November, 1956, until the end of the year. Mr. H. K. Ashby, Senior Agricultural Officer, Grade A, was posted to Headquarters, Kuala Lumpur, from Johore and assumed duty as Acting Assistant Director of Agriculture (Field) with effect from the 11th April, 1956. He remained in that post until the 13th September, 1956, when he proceeded on leave.

(iii) *Research Branch.*

132. Mr. L. N. H. Larter, Senior Research Officer, Grade A, acted as Assistant Director of Agriculture (Research) until the 27th January, 1956, when he proceeded on leave. Mr. F. B. Brown, Botanist, acted as Senior Research Officer, Grade A, until the 8th January, 1956, after which the post was reduced to Grade B. Mr. A. E. Billington, Senior Research Officer, Grade A, assumed duty as Acting Assistant Director of Agriculture (Research) with effect from the 28th January, 1956, and carried out the duties of that post until the 24th June, 1956.

133. Mr. K. Kanapathy, Chemist, assumed duty as Acting Research Officer, Grade A, with effect from the 5th July, 1956, and continued to carry out those duties until the end of the year.

134. Mr. J. K. Coulter, Senior Research Officer, Grade B, acted as Senior Research Officer, Grade A, throughout the year.

(iv) *Education Branch.*

135. Mr. J. Chattaway, Senior Lecturer, assumed duty as Acting Principal, College of Agriculture, with effect from the 11th August, 1956, and carried out those duties until the 20th November, 1956.

(v) *Agronomy Branch.*

136. Mr. E. F. Allen, Senior Agronomist, was appointed to act as Assistant Director of Agriculture (Field) with effect from the 15th November, 1956, on return from leave, and remained in that post until the end of the year. Mr. R. Henderson, M.C., Agricultural Officer, was appointed to act as Senior Agronomist, with effect from the 12th May, 1956, in which post he remained until the end of the year.

2. RECRUITMENT

137. Mr. S. J. Navaratnam, B.Sc. (Hons.), was appointed Pupil Plant Pathologist with effect from the 3rd November, 1956.

3. TRANSFERS

138. Dr. C. C. Webster, Ph.D., B.Sc. (Agric.), Dip. Agric. (Wye), A.I.C.T.A., Chief Research Officer, Kenya Agricultural Service, was appointed Deputy Director of Agriculture, Malayan Agricultural Service, with effect from the 12th January, 1956.

139. Mr. J. Cook, B.Sc. (Hons.), A.I.C.T.A., Assistant Director of Agriculture (Field), was transferred to Sarawak on promotion to the post of Director of Agriculture there with effect from the 14th January, 1956.

140. Mr. E. J. H. Berwick, M.A., Dip. Agric. Sci. (Cantab.), A.I.C.T.A., Senior Agricultural Officer, Grade A, was transferred on promotion to the post of Director of Agriculture, British North Borneo, with effect from the 10th July, 1956.

141. Mr. M. J. Smith, B.Sc. (Hort.), D.T.A., Agronomist-on-probation, was transferred to British North Borneo, with effect from the 6th October, 1956.

142. Mr. B. C. Balbernie, B.Sc. (Agric.), D.T.A., Agronomist-on-probation, was transferred to Sarawak with effect from the 22nd December, 1956.

4. RETIREMENTS

143. The following officers retired during the year:

(1) Mr. R. J. A. W. Lever, B.Sc. (Hons.) (Dunelm.), D.I.C. (Lond.), A.I.C.T.A., F.L.S., Entomologist, with effect from the 30th August, 1956.

(2) Mr. D. S. Boyce, B.Sc. (Agric.) (McGill), M.Sc. (Dunelm.), Assoc. Mem. A.S.A.E., A.M.I.B.E., Agricultural Engineer, with effect from the 11th November, 1956.

- (3) Mr. J. R. Curry, Dip. Agric. Sci. (Dunelm.), N.D.A., Assistant Director of Agriculture (Field), with effect from the 8th February, 1956.
- (4) Che Mohd. Ramly bin Haji Tahir, M.B.E., Assistant Agricultural Officer, with effect from the 8th April, 1956.

5. PROMOTIONS

144. Mr. J. Cook, Senior Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade A, Federation of Malaya, with effect from the 1st January, 1955, and to the post of Assistant Director of Agriculture (Field), Federation of Malaya, with effect from the 13th October, 1955.

145. Mr. H. J. Simpson, P.J.K., Senior Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade A, Federation of Malaya, with effect from the 1st January, 1955 and to the post of Assistant Director of Agriculture (Field), Federation of Malaya, with effect from the 14th January, 1956.

146. The following Senior Agricultural Officers were promoted to the post of Senior Agricultural Officer, Grade A, with effect from the 1st January, 1955:

Mr. E. J. H. Berwick

Mr. H. K. Ashby

Dr. W. N. Scott.

147. Mr. P. A. Gething, Senior Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade B, Federation of Malaya, with effect from the 1st January, 1955, and to Senior Agricultural Officer, Grade A, with effect from the 13th October, 1955.

148. Mr. P. G. Coleman, Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade B, Federation of Malaya, with effect from the 13th October, 1955, and to Senior Agricultural Officer, Grade A, with effect from the 14th January, 1956.

149. Mr. H. M. James, Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade B, Federation of Malaya, with effect from the 14th January, 1956, and Senior Agricultural Officer, Grade A, with effect from the 11th July, 1956.

150. Mr. R. Henderson, M.C., Agricultural Officer, was promoted to the post of Senior Agricultural Officer, Grade B, Federation of Malaya, with effect from the 11th July, 1956.

151. Mr. L. N. H. Larter, Senior Research Officer, Grade A, was promoted to the post of Assistant Director of Agriculture (Research), Federation of Malaya, with effect from the 9th January, 1956.

152. Mr. A. E. Billington, Senior Research Officer, Grade B, was promoted to the post of Senior Research Officer, Grade A, Federation of Malaya, with effect from the 9th January, 1956.

153. Mr. F. B. Brown, Botanist, was promoted to the post of Senior Research Officer, Grade B, Federation of Malaya, with effect from the 9th January, 1956.

154. Mr. J. K. Coulter, Soils Chemist, was promoted to the post of Senior Research Officer, Grade B, Federation of Malaya, with effect from the 14th January, 1956.

155. Che Ahmad bin Jamal, Assistant Agricultural Officer, was promoted to the post of Agricultural Development Officer, Federation of Malaya, with effect from the 1st June, 1956.

156. The following officers who proceeded overseas for training to equip themselves for promotion to posts in Division I returned to Malaya in 1956:

- (1) Che Basir bin Ismail, B.Sc. (Agric.) (Dunelm.), who was promoted to Pupil Agricultural Officer with effect from the 20th July, 1956.
- (2) Che Khalid bin Abdul Rahman, B.Sc. (Agric.), who was promoted to Pupil Agricultural Officer with effect from the 20th July, 1956.
- (3) Che Mohd. Tamin bin Yeop, B.Sc. (Agric.), who was promoted to Pupil Agricultural Officer with effect from the 19th November, 1956.

6. TECHNICAL ASSISTANCE, COLOMBO PLAN

157. Dr. R. G. Lockard, a Technical Officer on loan to Malaya from Canada under the Colombo Plan, completed his term of office and left Malaya on the 19th April, 1956. He returned to Malaya on the 27th November, 1956, for a period of two years further service in Malaya.

7. LEAVE

158. The following officers were on leave in the United Kingdom at the close of the year:

Dr. C. C. Webster, Ph.D., B.Sc. (Agric.), Dip. Agric. (Wye),
A.I.C.T.A.

Mr. H. K. Ashby, B.A. (Hons.), Dip. Agric. Sci., A.I.C.T.A.

Mr. I. J. Wyatt, B.Sc. (Hons.), Dip. Agric. Sci. (Cantab.),
D.T.A.

Mr. D. L. Stacey, B.S.A. (U.B.C.).

Mr. A. E. Billington, M.A., A.R.I.C.

Mr. P. A. Gething, M.A., Dip. Agric. Sci. (Cantab.), A.I.C.T.A.

Mr. C. Whitehead, B.Sc. (Hort.), D.T.A.

8. DEATHS

The Director of Agriculture records with deep regret the deaths of Enche Mohamed Kassim bin Long, Junior Agricultural Assistant, Federal Headquarters, Kuala Lumpur, on the 12th August, 1956, and of Enche Mohammed Yunus bin Mohd. Din, Assistant Agricultural Officer, Malacca, on the 7th November, 1956.

SECTION IV

WORK OF THE DEPARTMENT OF AGRICULTURE

A.—RESEARCH AND INVESTIGATION

159. The part in the investigational work of the Department carried out by the Research Branch has developed considerably during the past year, particularly in the fields of plant breeding, plant nutrition, and soil surveying and analysis. The implementation of three first-priority schemes under the Draft Development Plan is enabling the Branch to proceed more rapidly with soil surveying of undeveloped land and to accelerate the inevitably slow work of breeding improved varieties, in particular of padi and coconuts. The need for additional staff in connection with these schemes has been recognized and considerable expansion of the junior staff has been approved by Government. The experience gained in the past two years by the more recently recruited senior officers is bearing fruit, as is evidenced by the increase in the number of research reports submitted for publication from four in 1955 to eight in 1956.

1. PADI (RICE)

(i) *Variety Selection and Breeding.*

160. The programme of padi varietal improvement work outlined in the 1954 Annual Report has been continued through 1955 and the past year with, as was then suggested, increasing emphasis on selection in hybrid populations. To facilitate this, an additional 51 acres of land adjacent to the Padi Experiment Station, Telok Chengai, Kedah, have been acquired with the aid of Draft Development Plan funds and negotiations are in progress for a 20 to 30 acre extension of the Padi Experiment Station, Pulau Gadong, Malacca. Inter-varietal selection of indigenous and introduced unselected varieties is rapidly giving way to pure-line selection, though a few promising unselected varieties are still occasionally found.

161. (a) *Variety Trials.*—A number of yield trials which were successfully completed during the year will be more fully reported in a special bulletin to be published later, but the following are worthy of mention here:

Kedah—

At two padi test stations, Kepala Batas and Sala Kanan, selections of the variety Subang Intan were consistently superior in yield to other local varieties under trial. At Kepala Batas Padi Station, Subang Intan 117 significantly outyielded all other varieties under test and gave a 15 per cent yield increase over the control variety Mayang Ebos 80. At Sala Kanan Padi Test Station, Subang Intan 16 averaged 3,524 lb. per acre over the three-year period of the trial; this represents a 28 per cent increase over Mayang Ebos 80. In another trial of local and introduced varieties at this station, Radin Che Ali, Lawang Lawi and Seri Raja gave similar yields

and were all consistently better than Radin Kelumbong, Radin China 17 and Nang Tani 28.

Perak—

Two similar trials at Bruas and Sungei Manik Padi Test Stations compared the local varieties Radin Che Ali and Seri Raja with two selections of each of the Kedah varieties Mayang Tekai and Serendah Sungei Dua. Results of the tests were identical in that the local varieties, between which there were no differences, significantly outyielded the rest. The mean yield of each variety over three seasons was a little more than 2,100 lb. of grain per acre.

Two varietal trials which have been in progress for the last seven years at Chenderong Balai Padi Test Station have been concluded. One was sited on deep peat (more than 3 ft.) and the other on shallow peat (0 to 3ft.). Damage by pests and diseases was excessive in all seasons as the station became isolated from other padi cultivation and yield results are therefore inconclusive, but there are indications that a successful crop could be grown on such soils.

Pahang—

Three identical trials containing short-term and medium-short-term varieties at Dong, Kerdau and Temerloh Padi Test Stations have now been completed. The short-term varieties Radin Kling and Haji Haroun failed at all three stations due to excessive bird damage and were omitted from the final statistical analysis. The most successful variety at both Dong and Temerloh was Aceh Puteh, the mean yields of which over four years were 3,684 and 2,378 lb. per acre at those two stations. At Kerdau, also, it was one of the higher yielding varieties (1,490 lb. per acre), but its yield was surpassed by Anak Ikan Rendah (1,689 lb. per acre) and Radin Goi (1,627 lb. per acre).

Johore—

Two trials at Tangkak Padi Test Station which were held in abeyance from 1950 to 1953 have now been completed. They were originally reported in *Bulletin No. 25 (Scientific Series)* by L.N.H. Larter (Trials J. 1/47 and J. 5) after two years' duration; the final results are similar. Siam 29 (2,687 lb. per acre) and Aceh Puteh (2,593 lb. per acre) are thereby confirmed as the varieties to be recommended for the areas represented by this station.

162. These trials, mostly of unselected varieties, have in general been replaced by trials of new pure-line selections, but at Kepala Batas and Sala Kanan, Kedah, some Sarawak varieties which have shown considerable promise in observation plots are now under test.

163. At the Pahang stations, local varieties have been put into field trials following several years' successful growth in observation plots.

164. Observation plots of the Sarawak varieties Engkatek and Bungka Muda have been continued in all States and Settlements. The former is a high yielding, medium-term variety of short stature with very strong straw which produces high quality rice. In addition, replicated field trials containing these and other promising Sarawak varieties have commenced in Kedah, Perak and Malacca.

165. Observation plots of short-term varieties have been planted at Bukit Merah Padi Experiment Station, Province Wellesley, for evaluation of their use as a main season crop suitable for this double-cropping area.

166. (b) *Variety Survey*.—The five collections of Malayan varieties, totalling 1,264 strains, have been maintained as before. They are as follows:

	No. of Lines
(1) Medium and short-term varieties—	
Telok Chengai P.E.S.*	216
Pulau Gadong P.E.S.	482
Kota Bharu P.E.S.	368
(2) Long-term varieties—	
Titi Serong P.E.S.	150
Jelawat P.T.S.†	48
Total ...	1,264

Further evaluation of these varieties has not been possible due to lack of staff.

167. Six deep-water varieties have been introduced from East Pakistan for possible use in the Pahang *paya* (swamp). These have been grown at Kuala Lumpur, but due to their precocious flowering and heavily-awned grains they do not seem promising or acceptable.

168. Seventy-six varieties from Ceylon, Burma, Thailand, Indonesia, the Philippines, India and Pakistan have been received from the F.A.O. Regional Office, Bangkok, and are being grown under observation at Telok Chengai, Pulau Gadong and Kuala Lumpur. This is part of an F.A.O. project in which suitable varieties will be grown in a co-operative variety trial in various countries in South-East Asia. Growth of many of them at Telok Chengai has been very good, but at Kuala Lumpur and Pulau Gadong they have shown less promise. Many are of ultra-short maturation period and may be useful for breeding, but others display undesirable characters such as weak, spreading straw and very open panicles and will eventually be discarded in Malaya.

* P.E.S.—Padi Experiment Station † P.T.S.—Padi Test Station.

169. Short-term varieties have also been introduced from India, Thailand and Japan for possible use in breeding programmes and they are under observation at Kuala Lumpur.

170. (c) *Variety Selection*.—Pure-line selection within 14 major wet padi varieties has continued, and it has commenced with *padi tugalan* (semi-dry lowland padi) at Melor Padi Test Station, Kelantan. All the major varieties of *padi tugalan* have been bulked together for the purpose of selection and comparison.

171. No further recommendations for mass distribution to farmers have been made, but four more selections are in the final test year. Some reduction in the number of lines of varieties under selection has been made. The selection programme in the 1956-57 season is given in Table II.

TABLE II
PADI SELECTION PROGRAMME, 1956-57 SEASON

State or Settlement	Variety	Number of Selections Planted	
		1955	1956
Kedah.. ..	Radin Ebos	50+12*	25+12*
"	Radin Kling	200	32
Penang and Province Wellesley	Mayang Sa-Batil ..	40	40
"	Kontor	1,000	598
Perak	Mayang Sa-Batil ..	60	48
"	Seraup	45+15*	45+15*
"	Machang	1,000	1,000
"	Seri Raja	{ 585 810	{ 585 810
Selangor	Acheh Puteh	{ 96 42	{ 96 42
Negri Sembilan ..	Serendah Kuning ..	48+20*	48+10*
"	Serendah Puteh ..	1,495	1,495
Malacca	Nachin	42+20*	42+10*
"	Siam	40	40
Kelantan	Anak Naga	100	75
"	Mayang Sa-Gumpal ..	811	811
"	Padi Tugalan	nil	2,201
Total		6,351	8,080

172. The appearance of the Radin Kling lines at Telok Chengai Padi Experiment Station, Kedah, and the subsequent yield records confirmed the suspicion that this variety was already a pure line and selection has therefore been curtailed. Thirty-two of the lines have, however, been retained for further observation.

173. (d) *Trials of Pure-Line Selections*—(1) *Radin Ebos (Perlis and Kedah)*.—A preliminary trial of five Radin Ebos selections at Seriab Padi Test Station, Perlis, has been extended for a further year because of partial failure due to drought in one year.

* From mass selection

174. The final variety trial of 47 selections and two controls is now in its last year at Telok Chengai, Kedah. The combined results of the first two years indicated that several selections were likely to outyield Mayang Ebos 80 and Radin China 4 significantly, and some of these have been planted in multiplication plots this season for possible use in an extension trial in 1957-58.

175. (d)—(2) *Mayang Sa-Batil* (Penang, Province Wellesley and Perak).—Owing to widespread damage due to the physiological disease *penyakit merah* in the 1954-55 season, the series of trials of Mayang Sa-Batil (M.S.B.) selections has been extended for a further year at all stations except Kuala Kurau, Perak. There, five new selections significantly outyielded M.S.B. 8, the present standard pre-war selection of this variety; the selection giving the most consistently high yield was M.B.S. 19, with a mean yield of 3,231 lb. per acre over the last three seasons, while that of M.S.B. 8 was 2,780 lb. per acre. This selection has also done well at the other stations and is being multiplied up in anticipation of an extension trial in 1957-58.

176. (d)—(3) *Seraup* (North Perak).—The new Seraup selections have been most promising in their first year of trial at Titi Serong Padi Experiment Station, Perak, and Simpang Tiga Padi Test Station, Krian, Perak. At the former station one of these, Seraup 50 (2,875 lb. per acre), gave a 49 per cent greater yield than Seraup Kechil 48 (S.K. 48) (1,930 lb. per acre); at Simpang Tiga, Seraup 50 gave 1,611 lb. per acre, a 50 per cent increase over the control (S.K. 48). At both stations, all 15 selections under trial gave yields greater than that of the control, S.K. 48. Seraup trials have been laid down this year at three additional stations in Perak, viz., Kuala Kurau (North Krian), Bruas (Central Perak) and Sungei Manik (South Perak), and observation lines are now growing at Genting Padi Test Station, Penang. At Bruas Padi Test Station, which is generally subject to *penyakit merah*, the trial should also indicate whether any of the new selections show resistance to this disease. So far this season (1956-57), little *penyakit merah* has appeared there, but where it has, some lines appear to be particularly susceptible.

177. (d)—(4) *Serendah Kuning* (Negri Sembilan, Malacca and Pahang).—The final selection trials of Serendah Kuning strains at three Negri Sembilan stations have now been completed. Over the whole State, Serendah Kuning 11 has proved to be the highest yielder. Recommended strains for areas served by the various stations are Ser. Kun. 11 for Ulu Klawang and Ampang Tinggi and Ser. Kun. 29 for Kendong (subject to confirmation by extension trials). Various other selections have shown up equally well at Ampang Tinggi and Kendong and are being tested in extension trials in 1956-57. A new series of trials, incorporating selections not previously tested, has been started this year at all three stations. A trial is also in progress at Alor Gajah Padi Test Station, Malacca, to provide a suitable recommendation for the inland districts of Malacca.

178. Serendah Kuning selection trials are in progress at Kerbau, Dong and Pahang Tua Padi Test Stations, Pahang, and are represented in observation plots at Chenor Padi Test Station, a new station in Pahang which has replaced that at Temerloh. Selections No. 11, 29 and 31 continue to outyield the control variety Radin China 17, but recommendations for release to planters cannot be made until the trials are complete.

179. (d)—(5) *Nachin (Malacca and Johore)*.—Nachin 57 has been released for large-scale distribution to farmers and Nachins 2 and 39 are under further trial this season.

180. A new trial of Nachin selections at Tangkak Padi Test Station, Johore, has been damaged by rats and yields are expected to be low. Vegetative growth was, however, excellent.

181. The first season's results from the Nachin variety trial at Telok Chengai, Kedah, were not encouraging. No selection equalled the control variety, Mayang Ebos 80, in yield and all lodged severely.

182. (d)—(6) *Siam (Malacca)*.—Variety trials of 24 new Siam selections are in progress at Telok Chengai Padi Experiment Station, Kedah, and at Pulau Gadong Padi Experiment Station and Jasin Padi Test Station, both in Malacca. So far, there appear to be no outstanding strains but several have equalled or slightly surpassed the yield of Siam 29 and have stronger straw.

183. (e) *Extension Trials*.—A number of the extension trials in progress in 1955 have been completed and only three such trials have been carried out in 1956. As a result of these trials, cultivation of the more successful of the varieties tested is already extending in several areas. In anticipation of completion of final variety-selection trials now in progress, new strains are being bulked up for extension trials in 1957; they are as follows: Radin Ebos (Kedah), Mayang Sa-Batil and Seraup (Perak, Province Wellesley and Penang), Serendah Kuning (West Pahang), Nachin and Serendah Kuning (Malacca) and Subang Intan (Kelantan).

184. (e)—(1) *Mayang Sa-Batil 8, Machang and Seraup Kechil 48 in North Krian, Perak*.—This trial was continued in four mukims (parishes), Parit Buntar, Bagan Tiang, Tanjong Piandang and Kuala Kurau. Machang was consistently higher yielding in all mukims but, as was reported last year, differences were not statistically significant. Results of other trials in Perak were difficult to interpret because in most cases the control variety was the same as that under test.

185. (e)—(2) *Serendah Kuning in Negri Sembilan*.—The extension trial using Ser. Kun. 5003, 5011 and 5023 in progress in all districts of Negri Sembilan for three seasons has now been terminated and a summary of results is given in Table III. These have been calculated for both district and mukim recommendations.

TABLE III
PERCENTAGE YIELD INCREASES IN NEGRI SEMBILAN

District	By Districts				By Mukims			
	1953	1954	1955	1953-55	1953	1954	1955	1953-55
Kuala Pilah	4.8 (11)*	12.6 (11)	7.3 (11)	7.4 (11)	5.8	15.3	8.8	7.9
Rembau	14.5 (11)	23.7 (11)	20.2 (23)	18.0 (11)	25.0	25.3	32.4	24.4
Tampin	10.3 (11)	26.2 (11)	14.5 (23)	15.0 (23)	19.2	29.9	18.1	18.6
Jelebu	12.8 (3)	15.5 (3)	6.2 (11)	9.9 (3)	13.9	18.5	13.6	12.7
Seremban	43.6 (23)	43.0 (23)	34.5 (11)	38.8 (23)	49.8	45.0	35.9	41.1
Port Dickson	—	28.7 (23)	6.2 (11)	15.3 (23)	—	28.7	9.9	19.8
Negri Sembilan	10.2 (11)	17.0 (11)	12.3 (11)	12.9 (11)	16.8	23.6	17.3	17.0

186. The mean increase over the three-year period resulting from the use of Ser. Kun. 5011 in Kuala Pilah and Rembau, Ser. Kun. 5003 in Jelebu and Ser. Kun. 5023 in Tampin, Seremban and Port Dickson is of the order of 2,400 tons of milled rice per annum. By using the optimum strains for each mukim, this figure can be increased by another 450 tons. A further series of trials using Ser. Kun. 5003, 5011, 5029, 5031, 5037, 5050 and 5054 has been started this season.

187. (e)—(3) *Nachin 39 in Malacca*.—Following the success of *Nachin 57* in Malacca and the promising results with *Nachin 39* in trials, a new extension trial using *Nachin 39* has been sited in the coastal districts of Malacca this season.

(ii) *Quality Assessment*.

188. No further quality determinations have been carried out during the year, pending repairs to the laboratory mill.

(iii) *Hybridisation*.

189. The two hybridisation projects, *indica* × *japonica* and *indica* × *indica* (local), have continued at Pulau Gadong and Telok Chengai Padi Experiment Stations, and a limited number of progenies of the former are now established at Bukit Merah in Province Wellesley for selection of new varieties for main and off-season crops. It has still not been possible to record as much data as is desired from the ear-rows at these stations. The number of these has been reduced and no further selections have yet been made from progeny plots at Telok Chengai. With the increased amount of land now available and the promise of extra staff in 1957, it is hoped to expand this work considerably and introduce comparative yield trials for those lines of the oldest progenies which have shown little segregation during the past season.

190. (a) *Indica* × *Japonica* Hybrids—(1) *F₂ Generation*.—Thirteen additional samples, all of new crosses, have been received from the Central Rice Research Institute at Cuttack, India. They are:

HC. 62 Fukoku × Reyong 6

HC. 63 „ × Seraup Kechil 48

* Figures in brackets indicate varieties, viz. (11) = Ser. Kun. 5011, etc.

HC. 64	Fukoku	×	Acheh Puteh
HC. 65	„	×	Radin China 4
HC. 66	„	×	Mayang Sa-Gumpal
HC. 67	„	×	Mayang Sa-Batil 8
HC. 68	Zuihuo	×	Reyong 6
HC. 69	„	×	Seraup Kechil 48
HC. 70	„	×	Acheh Puteh
HC. 71	„	×	Radin China 4
HC. 72	„	×	Mayang Sa-Gumpal
HC. 73	„	×	Mayang Sa-Batil 8
HC. 74	„	×	Subang Intan.

All have been planted at both Pulau Gadong and Telok Chengai. Growth has been typical of these early generations with sporadic early flowering and partial sterility. Bird damage has been quite severe at Pulau Gadong where it was necessary to grow some plants outside the protective cage, but at Telok Chengai it has been negligible because the early local varieties were in flower at the same time. No selection work other than the discarding of very undesirable types is yet contemplated.

191. (a)—(2) *F₃ Generation*.—This is represented at both stations by the following crosses:

HC. 43	Fukoku	×	Serendah Kuning 3
HC. 44	„	×	Haji Haroun
HC. 45	Zuihuo	×	Haji Haroun
HC. 46	„	×	Serendah Kuning 3
HC. 47	Gimbozu	×	Siam 29
HC. 48	(Gimbozu × Serendah Kuning) × Serendah Kuning.		

The *F₂* crosses in the 1955-56 season were grown only at Pulau Gadong but have now been established at Telok Chengai in *F₃* progeny plots. At Pulau Gadong, extreme heterozygosity, both in vegetative and fruiting characters, was exhibited by all crosses but was less conspicuous in the backcross (HC. 48). Growth has been satisfactory at both stations in 1956 and no undue damage has so far been reported. Flowering commenced within 50 days of sowing in five crosses, but in HC. 48 it occurred 83 days after sowing, was more even and spread over a shorter period. Particulars of this generation are given in Table IV.

TABLE IV

CHARACTERS OF *F₃ Indica* × *Japonica* FAMILIES

Family	Days to 1st Flowering (sown 25-10-55)		Days to Last Harvest		Mean Maturation Period (days)		No. of Plants Selected		Yield of Selected Plants (gm.)	
HC. 43	..	48	..	164	..	95	..	14	..	25—73
HC. 44	..	41	..	163	..	90	..	5	..	30—45
HC. 45	..	48	..	163	..	105	..	16	..	25—50
HC. 46	..	55	..	163	..	110	..	21	..	35—60
HC. 47	..	48	..	163	..	100	..	30	..	40—90
HC. 48	..	83	..	163	..	140	..	29	..	35—60

192. (a)—(3) F_4 Generation.—At Pulau Gadong, 239 ear-rows and 14 progeny plots of seven simple crosses and seven backcrosses were planted in the 1955-56 season. Vegetative growth in general was much better in the ear-rows than in the progeny plots. *Nymphula* damage occurred in some plots after transplanting and rats and stem-borers destroyed 28 ear-rows later. The cross HC. 15 (Norin 20 $\times$ Nachin 57) seemed particularly susceptible to rat damage. Maturation periods of the simple crosses varied from 100 to 165 days; those of the backcrosses varied from 150 to 174 days. Yields of selected plants ranged from 30 to 75 gm. For 1956 planting, 166 ear-rows were retained and 79 new ones were added from the progeny plots, making a total of 245. These and the plants in the progeny plots have grown well so far.

193. At Telok Chengai two crosses only, HC. 1 (Norin 6 $\times$ Mayang Ebas 80) and HC. 28 (Gimbozu $\times$ Nachin 57), were grown in 1955-56, the former represented by seven ear-rows and the latter by six. Growth was very good, but HC. 1 included many awned plants. Eleven and twelve ear-rows, respectively, were selected for the 1956 sowing; plant yields varied between 96 and 127 gm. No selection was done in the progeny plots, but they were maintained from a random sample of seed from the previous season. Calculated acreage yields from progeny plots were 297 gtg. for HC. 1 and 232 gtg. for HC. 28.

194. (a)—(4) F_5 Generation.—At Pulau Gadong, the field performances of the ear-rows and progeny plots of the 34 crosses of this generation were again good in the 1955-56 season. Plants were more vigorous and uniform in growth. Ultra-earliness in flowering has been almost entirely eliminated and the duration of the flowering period has been reduced. A general improvement in other characters, especially straw strength, is apparent. Of 1,413 ear-rows planted in 1955, 915 were retained and 244 new ones were added from progeny plots, giving a reduced total of 1,159 for 1956-57. Examination of seed samples from these crosses has shown the presence, in almost all, of red grains. In HC. 16 (Asahi $\times$ Mayang Ebas 80) approximately 40 per cent were red. Such plants have been discarded.

195. At Telok Chengai, growth in both ear-rows and progeny plots was excellent in 1955-56 and plant yields from selected plants in ear-rows were as high as 175 gm. Few plants with yields below 100 gm. were selected for 1956-57. Acreage yields calculated from the progeny plots varied from 300 to 607 gtg. Many of the lines appear almost homozygous. Certain lines of HC. 17 (Asahi $\times$ Siam 29) and HC. 26 (Riku 132 $\times$ Nachin 57) were very susceptible to *penyakit merah*, while HC. 32 (Pebifun $\times$ Siam 29) showed very weak straw. Altogether, 677 ear-rows from 32 crosses are being grown this season with a progeny plot for each cross.

196. (a)—(5) F_6 Generation.—At Pulau Gadong, the four crosses of this generation are represented in the 1956-57 season by 188 ear-rows and four progeny plots. Segregation is still apparent, but to a much lesser degree, and growth, plant height,

flowering period and maturation of the ear-rows are fairly uniform. More detailed records are now being taken.

197. At Telok Chengai Padi Experiment Station, 179 ear-rows are now being grown; 149 had been retained from the 1955-56 season and 30 are new additions. Yields from progeny plots averaged about 450 gte. per acre. HC. 59 (Nachin 57 $\times$ Asahi) showed a large percentage of weak-strawed plants and some empty grains.

198. (a)—(6) *Off-Season Crop*.—Eight F_5 and four F_6 progenies were planted at Bukit Merah Padi Experiment Station, Province Wellesley, in the 1956 off-season. Vegetative growth was comparable with local varieties and segregation was not excessive. All flowered out of season, but grain yields were not as high as was hoped. Nevertheless, 329 plants were selected for planting off-season ear-rows in 1957. Meanwhile, main-season progeny plots are also being continued.

199. (b) *Hybrids of Local Varieties*.—A summary of the local hybrids planted in 1956-57 is given in Table V.

TABLE V

Indica $\times$ *Indica* POPULATIONS PLANTED

Hybrid	Pulau Gadong		Telok Chengai		Total	
	Ear-rows	Progeny plots	Ear-rows	Progeny plots	Ear-rows	Progeny plots
F_4	304	16 ..	684	15 ..	988	31
F_5	920	28 ..	1,219	28 ..	2,139	56
F_6	402	9 ..	158	9 ..	560	18
	<u>1,626</u>	<u>53 ..</u>	<u>2,061</u>	<u>52 ..</u>	<u>3,687</u>	<u>105</u>

200. No further selections were made from progeny plots during the last season and the number of ear-rows was reduced at both stations. Growth and yields were very good and the F_6 progenies are now suitable for normal ear-row selection and preliminary yield trials as soon as staff is available. Crosses in which Nachin 11 is the female parent are very liable to lodge; and those in which Gaharu is either the male or the female parent contain up to 40 per cent *pulut* (glutinous) grains. Haji Haroun crosses are giving segregants with a red pericarp. One such cross at Telok Chengai was found to consist of 100 per cent red grain and has been discarded there and replaced with fresh material from Pulau Gadong. The cross Siam 29 $\times$ Banyak Anak gave a yield of approximately 4,700 lb. per acre from a progeny plot at Pulau Gadong and Nachin 11 $\times$ Siam 29 gave approximately 4,000 lb. per acre at Telok Chengai. Yields at the latter station were generally higher than at Pulau Gadong, and at both stations yields of the older progenies were quite comparable with those of the local varieties.

201. A new series of 32 crosses is planned for early 1957 and parental material is growing in the cage at Kuala Lumpur. The object of this new programme is to produce new short-term,

strong-strawed varieties resistant to *penyakit merah*, using high-yielding selected varieties with Engkatek (strong strawed), Radin Kling (short-term, non-photosensitive) and Seri Raja (resistant to *penyakit merah*) as the other parents.

202. The wild rice *Oryza ridleyi* appears to be relatively immune to stem-borer attack and some exploratory crosses using Siam 29 and this variety have been made. The seed-set has been very poor.

(iv) *Induced Mutation.*

203. (a) *X-Rays*.—Forty-three plants obtained from irradiated (5000 r.) Siam 29 seedlings were grown in the padi cage at Pulau Gadong in 1955-56. All plants appeared to have been affected by the treatment and all were shorter than normal Siam 29. In some plants, stunting, twisted or geniculate stems and shortening of the lamina were observed during the vegetative stage. At flowering, plants which were severely stunted and twisted produced only empty grains. Fully and partly sterile ears were observed in most plants and no fully fertile ears were produced. Only 13 plants gave sufficient fertile seed for the X_1 generation and these have all produced plants with straw much stronger than that of normal Siam 29.

204. Cytological study of the pollen mother cells of the 43 plants of the X_0 generation is in progress. Plants having pollen mother cells which show abnormal pairing (Table VI) have chromosomal aberrations of the following types at meiosis: chain or ring of four chromosomes; fragmentation; and bridge and fragment. It is of interest to note that although 16 plants had normal meiosis, only eight gave viable seeds. It appears that X-irradiation affected genes which control seed viability without impairing the meiotic process.

TABLE VI
EFFECT OF X-IRRADIATION ON SIAM 29

					No. of Plants	No. of Plants giving Fertile Grains
Meiosis ..	{	Normal pairing	16	8		
		Abnormal pairing	11	0		
Pollen ..	{	Normal	3	3		
		Empty	6	0		
Unexamined ..			7	2		
Total ..				43	13	

205. (b) *Polyploidy*.—Experiments with colchicine treatment of germinating seeds have continued and a satisfactory technique, similar to that used in Japan by Masima and Uchiyamada, has been evolved. This technique consists of germinating seeds to the two-leaf stage, then transferring them to monel wire mesh with roots on one side and shoots on the other. The shoots are trimmed and inverted into 0.2 per cent colchicine for 24 hours. Only the vegetative growing point is affected and the roots do not come

into contact with the colchicine but are kept damp with wet filter paper. The shoots are washed in running water for three hours and planted out after further growth.

206. Fifty-two treated plants have been grown; most look normal, but a few plants have an odd tiller which has much larger, coarser grains with long awns. These are typical of tetraploid grains. One tiller has both normal Siam 29 grains, on one side, and the larger awned type, on the other side of the same panicle. Cytological examination of these abnormal grains will be carried out later.

(v) *Natural Cross-Pollination.*

207. This experiment has now been completed at Pulau Gadong and a full report is being prepared. The outcrossing obtained was 0.40 per cent.

(vi) *Photosensitivity.*

208. A new experiment commenced in March was designed to reproduce, under controlled conditions with the elimination of day-to-day variation in day length, the effect of planting padi in and out of season. The treatments fall into two groups, viz: long days (LD) followed by short days (SD), then by long days again until harvest, to simulate planting in the period April to August; and short days followed by long days and then short days until harvest to simulate plantings between September and March. The treatments thus telescope seasonal variation in day length into a short period. Two varieties are being tested, Siam 29 which is highly photosensitive and Radin Siak 34 which is less sensitive. The interim results are given in Table VII.

TABLE VII

EFFECT OF LIGHT TREATMENT ON GROWTH PERIODS (DAYS)

Treatment*	Siam 29			Radin Siak 34		
	Sowing to Flowering	Sowing to Harvest	Flowering to Harvest	Sowing to Flowering	Sowing to Harvest	Flowering to Harvest
A. 0 SD+28 LD+SD	68	115	47	104	139	35
B. 14 SD+28 LD+SD	81	121	40	99	153	54
C. 28 SD+28 LD+SD	99	136	37	106	140	34
D. 42 SD+28 LD+SD	87	119	32	112	148	36
E. 0 LD+28 SD+LD	Has not yet flowered			172	193	21
F. 14 LD+28 SD+LD	65	105	40	179	212	33
G. 28 LD+28 SD+LD	66	112	46	162	201	39
H. 42 LD+28 SD+LD	86	123	37	99	137	38

209. Two "date of sowing" experiments have been started, at Kota Bahru, Kelantan, and at Pulau Gadong, Malacca; in the former, three varieties are under test, in the latter, seven. Sowing takes place at four weekly intervals and thereafter the stage of growth of the panicle is determined by dissection of tillers every 14 days. In addition, further varieties are under observation at Pulau Gadong Padi Experiment Station in order to test their photoperiodic reactions.

*SD=short days; LD=long days.

(vii) *Seed Germination.*

210. An experiment to study the effect of environment on the germination of padi seed has been completed and a report has been prepared for publication. The results indicated that among the treatments tested the highest percentage germination was obtained in the absence of fertiliser and in running water. A reduction in germination, either when the seed was buried or when a fertiliser containing ammonium sulphate was used, was possibly due to a low reduction-oxidation potential or to the absence of light or both.

211. A study of the effect of different nitrogen fertilisers on germination in wet nurseries has also been completed. The most uniform germination was obtained by using calcium cyanamide, whilst the highest fresh weight of seedlings was produced when ammonium sulphate was used. The latter chemical, however, reduced percentage germination considerably. Ammonium phosphate application, which is the present standard nursery manurial treatment, gave a slightly lower percentage germination than calcium cyanamide and the seedlings were less uniform.

212. An experiment to discover whether treatment of seed with a mercurial fungicide before storage has a deleterious effect on germination showed that there was no such effect. The experiment was continued for a year. Towards the end of that period, treatment immediately before sowing gave an increase in percentage germination over that of the untreated controls, an effect which was not obtained by treating before storage.

(viii) *Nutritional Studies.*

213. Preparations are under way for a series of sand culture experiments to study the effect of nutrient unbalance on the padi plant and the toxicity and deficiency symptoms of a limited number of the minor elements.

214. Two samples of padi seedlings, one from a manured and the other from an unmanured nursery, were analysed. The seedlings from the manured nursery had a much higher percentage of P and were also much larger than those from the unmanured one.

215. (a) *Penyakit Merah.*—Owing to the very low incidence of *penyakit merah* in the 1955-56 padi season, no results were obtained from the fertiliser and varietal trials which were then in progress in this connection.

216. The current programme of field work is limited to a series of simple two-plot trials which have been laid down in four districts, Rantau Panjang and Bandar Bahru in Kedah, Bruas in Perak and Panchang Bedena in Selangor, where *penyakit merah* normally occurs. The treated plot received a fertiliser dressing of sulphate of ammonia at 150 lb. per acre, Christmas Island rock phosphate at 280 lb. per acre and muriate of potash at 50 lb. per acre; the control plot received no manure. No *penyakit merah* has as yet occurred but discolouration, not coupled with stunting, is fairly common.

217. (b) *Toxicities*.—In the *penyakit merah* studies, five tanks in the padi cage at Kuala Lumpur were filled with soil from Kuang, Selangor. The unsatisfactory growth of seedlings in a nursery made from this material showed that it was very poor soil. Treatments were given to study the effects of highly reducing conditions, excess iron and H_2S ; the treatments were (i) sugar at 5 tons per acre applied ten days before transplanting; (ii) sequestered iron at the rate of 300 p.p.m. (iron to soil); (iii) as in (i) but with the roots of the plants slightly damaged; (iv) control; (v) 50 c.c. of water saturated with hydrogen sulphide were injected into the soil near each plant daily from two months after transplanting until harvest. In tanks (i) and (iii), the first set of seedlings died and it was necessary to transplant a second series. Growth of these was very poor and stunted in tank (iii), but that in (i) was quite good. The tanks with soil with high iron content had an oily film on the surface after flooding, but growth of the padi in them has not been too bad. Strangely enough, the H_2S injections have had no detrimental effects at all. The padi in the tanks is not yet ready for harvest. Characteristic symptoms of *penyakit merah* were not developed in any of the treatments.

218. In current experiments on Malacca *gelam** soils, the soil in one row of five tanks has been kept waterlogged with only surface movement of the water; in another row, the soil is leached daily by removing the bung at the bottom of the tank. Growth of padi is much better in the drained tanks. A liming treatment has been superimposed on both rows of tanks and lime is applied at rates equivalent to 0, 1, 2, 4 and 10 tons per acre. Growth is good in the last two treatments in both drainage treatments, but in the freely drained tanks it is noticeably better.

219. In two experiments carried out by the Plant Physiologist on the effect of heavy concentrations of arsenic and sodium on padi grown in sand culture, the plants were analysed for arsenic and, in the case of the sodium experiment, for sodium and other elements as well. The ability of salt-tolerant varieties to stand up to high salt concentrations appears, contrary to previous findings, to be due to their ability to absorb normal quantities of other nutrients, particularly potassium, while taking up much less sodium than non-tolerant varieties.

220. (c) *Padi on Peat*.—An experiment with wet padi on peat, begun at the end of 1955 in the padi cage at Kuala Lumpur, was completed and chemical analyses of some of the plants harvested at the flowering stage and of the straw at the fully matured state were carried out in the early part of 1956.

221. It showed that, under the conditions of this experiment, wet padi could be grown successfully on Jalan Kebun peat. The most important requirement was nitrogen, application of which nearly doubled the yield. The chemical analysis of the padi plants also confirmed that nitrogen was the most important factor required. There were very little differences in the percentages of other elements in the dry matter of the experimental and control plants at the flowering stage. It remains to translate these results to apply to field conditions.

* *gelam*—*Melaleuca leucadendron*, a dominant species on these undrained, sulphurous soils.

222. Two rows of five tanks are again being used for peat experiments. In one row, time of application of nitrogen is being examined and in the other, depths of water and depths of planting.

223. In the experiment on times of application of nitrogen, treatment (i), the control, is compared with the application of 3 cwt. of urea per acre, (ii) at transplanting, (iii) six weeks after transplanting, (iv) half at transplanting and half six weeks later, and (v) in four equal portions at transplanting and at four, eight and twelve weeks later. All the manured padi plants have grown very well, have tillered profusely and are now bearing heavy crops of grain. Eye-scores indicate that the order of growth vigour is (iii) > (iv) > (ii) > (v) > (i).

224. A series of pot experiments using the same peat was also set up; treatments were the same except that the nitrogen was applied at the rate of only 1 cwt. of urea per acre, equivalent to a normal field-dressing. Growth has been much less vigorous and again it would appear that a heavy dressing of nitrogen is more effective on peat.

225. In the second row of five peat-filled tanks (depth of planting experiment), the treatments were: (i) surface of peat kept just moist; (ii) normal planting in 4 in. of water; (iii) normal planting in 9 in. of water; (iv) deep planting in 9 in. of water; and (v) shallow planting in 2 in. of water. The order of growth vigour is (i) > (v) > (ii) > (iii) > (iv). (Vid. par. 471.)

226. (d) *Water Control*.—An experiment was commenced in May in tanks in the cage at Kuala Lumpur to test the effect of off-season soil treatment on the growth and yield of the main crop. The off-season treatments were: (i) soil kept wet; (ii) wet soil plus off-season padi; (iii) soil kept dry; and (iv) dry soil with an off-season tobacco crop. Uncropped wet and dry treatments were both left unweeded. The contrast between wet and dry uncultivated tanks in the off-season was very marked. Tanks which were kept wet (with one exception) produced a weed flora, mainly of *Monochoria vaginalis* and a small *Cyperus* sp., whilst the dry tanks grew tall *Fimbristylis miliacea* and *Cyperus digitatus*. The contrast was due entirely to the presence or absence of standing water. Some wet tanks also produced one or two self-sown padi plants, but none grew under the dry conditions. The exception in the wet tank mentioned above produced no vegetation whatsoever except a few self-sown padi plants. Previous treatments applied in this tank gave no explanation for this, but it may be that the competitive nature of the padi eliminated the weeds, as a similar condition was produced in the tanks occupied by the off-season-planted padi. All tanks have been planted with wet padi as a main crop and tanks are split to include normal (30-day-old) and over-aged (60-day-old) seedlings. Fortnightly tiller and height measurements which have been taken show that the planting of over-aged seedlings reduces both plant height and number of tillers, and differences due to off-season treatments are also apparent. Mean tiller number and plant height of the main crop at the end of the year are shown in Table VIII.

TABLE VIII

EFFECT OF SOIL CONDITIONS AND SEEDLING AGE ON GROWTH

Off-Season Treatment	30-Day-old Seedlings		60-Day-old Seedlings	
	No. of tillers	Plant height (cm.)	No. of tillers	Plant height (cm.)
A. Wet	22.2	46.5	10.0	35.5
B. Wet + padi	19.8	43.0	7.7	33.0
C. Dry	19.5	46.5	10.2	35.3
D. Dry + tobacco	27.2	54.7	14.8	36.2

227. Measurements of a number of soil characteristics have also been made at various phases of the experiment. These include water-holding capacity, moisture content of air-dried soil, pH and percentage of organic matter:

- (1) *Water-holding capacity* in wet and dry treatments had increased by the end of the off-season treatments but decreased to the initial value again at the commencement of the main-crop treatment. This increase was probably due to the undecayed weeds present at the end of the off-season treatment, the decrease resulting when these weeds decayed. Water-holding capacity in tanks cropped during the off-season remained unaltered.
- (2) Moisture content of air-dried soil did not fluctuate in wet treatments but decreased in the others at the end of the off-season crop and increased when water was applied for the main crop.
- (3) pH—Fluctuations as in (2) also occurred with pH. Results of changes in the percentage of organic matter have not yet been culculated. (Vid. par. 456 *et seq.*)

228. The treatments in a second experiment include complete waterlogging and complete drainage during the off-season and complete stagnation (by covering the surface of the water with boards and polythene) and free water movement during the growing-season. The test padi-plants are almost ready for harvest, but no outstanding differences have been noted in the different treatments.

229. The foregoing experiments, which were aimed at solving some of the problems of growing padi under abnormal soil-conditions and determining the conditions of drainage and irrigation militating against higher yields, added considerably to the fundamental knowledge of some of the factors concerned but they have not yet solved these problems. They have been of an exploratory nature and the future programme is aimed at elucidating the anomalies that have arisen and correlating the results which have been obtained so far.

(ix) *Insect Pests.*

230. (a) *Stem-Borers.*—The results of field investigations carried out by the Entomologist in the Krian district of Perak during the 1955-56 padi season and the previous off-season are in press as Department of Agriculture *Bulletin No. 102*. The

most important conclusions to be drawn from this work are as follows:

- (1) The main carry-over of stem-borers from one season to the next is on volunteer (self-sown) padi. Although a few borers can be found attacking some of the larger grasses and sedges, carry-over on these plants is unimportant.
- (2) There is a steady and rapid build-up of borers through the season. Although the population at planting time may be very low, by harvest the percentage of bored tillers may be extremely high.
- (3) Stem-borers appear to prefer vigorously growing padi to poor padi. Popular belief is contrary to this, because borers pass unnoticed in vigorous padi.
- (4) The numbers of tillers bored varied in different parts of Krian. At earing it was estimated that in the area of better soil in the north-west and south-west of the district 60 per cent of the tillers were bored, while in the poorer soil in the south-east the average was about 30 per cent.
- (5) The stage of growth at which borers cause most damage is at flowering. Although borers may be more numerous later, their damage then is unlikely to cause serious loss in yield.
- (6) Insecticidal spray experiments showed that considerable increases in yield could be obtained by application of this method, although complete control was not achieved. Complete control was not obtained even with fortnightly spraying throughout the growing season, but even a single spraying, when correctly timed, gave a significant increase in yield. Correct timing of the single treatment is essential; maximum benefit is obtained by spraying four weeks before flowering.

231. To follow up the work completed during the 1955-56 season, a further programme of investigations is being carried out in the 1956-57 season. With the co-operation of State and Settlement Agricultural Officers and their staffs, the following investigations are in progress:

- (1) Insecticide experiments to confirm whether stem-borers can be controlled by spraying and to estimate yield losses due to borer attack. Experiments are being carried out on padi test stations in Negri Sembilan, Province Wellesley, Johore, Selangor and Trengganu. The insecticide used is dieldrin or, where padi-field fish are of economic importance, DDT.
- (2) Fortnightly counts of bored tillers, throughout the season, to investigate the possibility of predicting borer outbreaks in any one season. These counts are being done at selected sites near padi test stations in Kedah, Selangor, Negri Sembilan, Johore, Kelantan and Trengganu.

- (3) A general survey of borer damage in the main padi areas of the Federation to assess the importance of stem-borers. This survey is made at the commencement of flowering and it is intended that it be repeated over a number of years. Surveys have so far been carried out in Kedah and Perlis, where approximately two per cent of the tillers were attacked, and in Krian, where the average proportion of bored tillers was about six per cent. The Krian figures, when compared with the 1955-56 season's figures, show that there is great variation in the severity of borer attack from year to year.
- (4) Comparisons of susceptibility of different padi varieties to borer attack. Counts of bored tillers are being made immediately before flowering in botanical varietal trials on padi test stations.

232. In addition to the work in the field, an insecticide pot-experiment is being done at headquarters to compare the efficiency of five insecticides, at equivalent concentrations, in the control of stem-borers. It is hoped that this will be followed up with further experiments to investigate formulations, application rates, placement of insecticides, etc. There is also an experiment in progress at Ulu Gombak, Selangor, to investigate the effect of artificial damage, simulating borer damage, on the regeneration and yield of the padi plant. The damage is inflicted at different stages in the growth of the padi.

233. (b) *Cnaphalocrocis*.—The life history of the moth *Cnaphalocrocis medinalis* Guen., the larvæ of which bend back the leaves of half-grown padi plants and feed on them, is being investigated. (Vid. par. 445.)

(x) Diseases.

234. (a) *Seed Infection*.—Fungi isolated or identified during the year, but not previously recorded from rice seeds in Malaya, included *Aspergillus tamarii*, *A. niger*, three species of *Curvularia* (*C. affinis*, *C. fallax* and *C. pallescens*), *Fusicladina* sp., *Penicillium vermiculatum*, *Rhizopus cohnii* and *Syncephalastrum racemosum*.

235. Of these, *Curvularia affinis* and *Fusicladina* sp. were found capable of attacking and killing young rice seedlings. In addition, *Pestalotiopsis disseminata*, previously recorded, was proved to be pathogenic.

236. Isolations were made from seeds originating on plants heavily attacked by blast (*Piricularia oryzae*). This fungus was not obtained from any of these seeds, which gives support to the view that *Piricularia* is not commonly seed-borne in Malaya.

237. (b) *Blast*.—Tests of the comparative susceptibilities of Malayan padi varieties to blast (*Piricularia oryzae*) were begun. These tests are being carried out as a result of discussions which took place at the F.A.O. International Rice Commission meeting in Penang in December, 1955. The varieties being tested are those listed in the F.A.O. *World Catalogue of Genetic Stocks*.

238. The disease was reported from several localities during the year. In one interesting case in which mature plants were severely attacked, the precipitating cause of the disease was the presence in the irrigation water of rubber-factory effluent. This acted as a nitrogenous fertiliser which rendered the padi unusually susceptible to attack by the disease.

239. (c) *Other Diseases*.—Other diseases reported from different parts of Malaya included leaf spots (*Helminthosporium oryzae* and *Cercospora oryzae*), false smut (*Ustilaginoidea virens*) and *penyakit merah*, but none caused serious or widespread damage, though false smut occurred much more commonly than usual.

2. OIL PALM

240. The main lines of work with oil palms during the year have been breeding improved varieties with particular reference to dwarf and *tenera* types and development of studies on mineral nutrition. Diseases and pests have been more in evidence than usual and intensive work on the bagworm, *Cremastopsyche*, has been called for.

241. Notable also has been the conclusion of an agreement between the Department and the United Planting Association of Malaya for co-operative breeding work on oil palms. The willingness of the four major commercial interests to provide land and material for this work has been very apparent and has at last provided a long-needed essential step in the preservation and development of one of the country's most promising agricultural industries.

(i) *Breeding and Selection*.

242. (a) *Breeding*.—As a result of the launching of the Co-operative Breeding Scheme (C.B.S.) and the contribution of breeding material to the scheme by the co-operating estates, there has been considerable development of the breeding programme in the past year. While the main lines of work continue to be the development of the Dumpy palm and of *tenera* types, it has become possible, owing to the availability of more land, to resuscitate incomplete breeding work which had been abandoned, expand the lines of work in progress and commence exploratory work on a number of promising ancillary investigations.

243. Nurseries of selected pedigree material have been laid down at the four C.B.S. estates, Ulu Remis, Klanang Bahru, Johore Labis and Jendarata Estates, with seedlings supplied from the Federal Experiment Station, Serdang, with a view to planting 200 acres of experiments by 1960.

244. During two weeks in April, two of the Department's Botanists visited oil palm estates and research institutes in Sumatra as the guests of Messrs. Harrisons & Crosfield (Malaya) Limited. As one result of the visit, an exchange of breeding material has been arranged with leading oil palm organisations in Sumatra.

245. Blocks I and II of trial 0.25 at the Federal Experiment Station, Jerangau, Trengganu, were planted in December, 1955, but the land for the other blocks could not be prepared until March, 1956. With the arrival of wet weather, blocks III, IV and V were planted in May, 1956. The trial is designed to compare seven semi-Deli *tenera* progenies with a control of Dumpy Deli palms.

246. Although Klanang Bahru Estate, Selangor, is one of the C.B.S. "host" estates, the two trials planted there this year were planned long before the scheme commenced. Five semi-Deli *tenera* progenies and a Dumpy Deli control were planted in a 12-acre trial (0.26) in January. The *tenera* seedlings all originate from Serdang Dumpy palms pollinated with *pisifera* pollen from the Institut de Recherches pour les Huiles et Oleagineux (I.R.H.O.) in French West Africa. Two of the *tenera* progenies and the Dumpy control are also represented in trial 0.25 at Jerangau. Growth has not been good, but only two experimental seedlings have died.

247. Trial 0.27 was planted in November under a stand of old coconuts at Klanang Bahru. Weather at and after planting was excellent for the purpose and healthy growth is expected. The trial is designed to compare the value of *dura* palms, which were being used for commercial plantings on the estate at the time, and four families of semi-Dumpy *tenera* palms. One of the *tenera* progenies is also represented in trials 0.25 and 0.26.

248. (b) *Selection*.—The yields of bunches from the various Elmina progenies growing in fields 3A and 4 at the Federal Experiment Station, Serdang, are given in Table IX.

TABLE IX
YIELDS OF ELMINA OIL PALM PROGENIES

Experiment No.	Field	Progeny	Total Weight of Bunches 1956 (tons per acre)	
0.1	4	E. 45	..	3.4
		E. 93	..	2.4
		E. 20	..	3.6
		E. 211	..	5.6
0.2	4	E. 97	..	4.1
		E. 152	..	3.6
		E. 207	..	4.1
		E. 216	..	5.6
		E. 268	..	6.2
Unreplicated	4	E. 268	..	4.9
		E. 366	..	5.5
		E. 120	..	5.1
		E. 206	..	3.1
Unreplicated	3A	E. 206	..	7.4
		E. 152 × 206	..	5.7
		E. 268 × 206	..	7.3
Field	Palm	Bunch Yield (tons per acre)	Oil Yield (tons per acre at 15% extraction)	
3A	Dumpy (E. 206)	7.4	..	1.11
3A	Semi-Dumpy	6.5	..	0.98
4	Tall	4.5	..	0.68

249. The palms in the first trial (0.8) of seedlings at Jerangau, which originated from Serdang and from Estates A and B, are growing vigorously and heavy yields have been recorded. As the palms were planted in November, 1952, only the figures for the first six months in bearing are at present available, but these clearly demonstrate the precocity of the Estate B strains (Table X).

TABLE X

OIL PALM PROGENY TRIAL 0.8 AT F.E.S. JERANGAU

Yield of Fruit for the First Three and Six Months in Bearing

Progeny	Origin	F.F.B.* (lb. per acre)		No. of Bunches per Acre		Mean Bunch Weight (lb.)	
		3 months Oct. to Dec., 1955	6 months Oct., 1955 to Mar., 1956	3 months Oct. to Dec., 1955	6 months Oct., 1955 to Mar., 1956	3 months Oct. to Dec., 1955	6 months Oct., 1955 to Mar., 1956
A	Estate A	2,148	4,191	277	479	7.7	18.1
B	"	2,235	4,715	287	524	7.8	18.3
C	Estate B	3,105	5,677	359	632	8.6	17.9
D	"	4,230	7,238	476	779	8.9	18.8
E	Serdang	845	2,915	77	213	11.2	26.1
F	"	1,054	3,301	120	250	8.8	25.7
M.S.D. at 5%		807	1,549	96	157	1.4	1.2

250. The high yields of C and D can be attributed mainly to the large number of bunches, which probably reflects the high number of palms bearing. Evidence that these strains are producing fewer male flowers than the other strains in the trial is to be checked.

251. The unreplicated observation plot (0.4) of Dumpy-backcross palms planted in May, 1951, on Highlands Estate, Selangor, was brought into bearing when the palms were four years old. The total weight and number of bunches harvested from each progeny are given in Table XI. Yields are very satisfactory. Individual palm recording, with the assistance of the estate staff, will commence in January, 1957.

TABLE XI

DUMPY-BACKCROSS

Yield Data for the Year ending November, 1956

Progeny	Total Bunch weight (tons per acre)	Mean Bunch Weight (lb.)	Yield of Oil (tons per acre at assumed 14% extraction)
<i>Dumpy</i> × <i>Semi-Dumpy</i> —			
1.1 × 12.3	8.4	16.4	1.2
1.1 × 14.2	7.3	16.9	1.0
1.7 × 12.3	9.6	18.7	1.3
1.7 × 14.2	8.2	19.3	1.1
3.5 × 12.3	8.2	16.9	1.1
3.5 × 14.2	6.8	16.6	1.0
<i>Semi-Dumpy</i> × <i>Semi-Dumpy</i> —			
10.8 × 14.2	8.4	19.2	1.2

* F.F.B. = Fresh Fruit Bunches.

252. Recording of the weight and number of bunches harvested from each progeny of the Dumpy and Dumpy-backcross trials (0.5 and 0.6) planted in November, 1951, on Ulu Bernam Estate, Perak, was continued during 1956. Complete records for the year are not available, but analysis of the figures for the first year in bearing showed no significant differences between the yields of progenies but a highly significant variation in the size of bunches from backcross progenies. Harvest records of individual palms will be taken from January, 1957.

253. The large block (0.11) of unreplicated Dumpy progenies planted in January, 1953, on Lanadron Estate, Johore, was brought into bearing in October this year and the weight and number of bunches harvested from each progeny is being recorded by estate staff.

254. (c) *Genetics*.—Height and girth measurements of the palms in Experiment 0.4 on Highlands Estate were taken in June. A sample of 158 palms from the area of estate palms surrounding the experiment and which were planted at almost the same time was also measured. The results are summarised in Table XII. Height was measured from ground level to the base of the leaf spear, and girth was measured over the leaf bases at 2 ft. above ground level.

255. At one time it was thought that the tall-dumpy habit is determined by a non-dominant pair of simple allelomorphic genes. Further F_2 and backcross progenies have now been established, but there is so far no evidence that the Dumpy-backcross seedlings are segregating into two or more distinct populations and it was surprising to find that not even one palm in the progeny of semi-Dumpy 10.8 $\times$ semi-Dumpy 14.2 had a girth greater than normal for tall palms. It was also disconcerting to find that these latter palms also behaved quite normally as regards the ratio between height and girth measurements, and the highest yielding progeny (1.7 $\times$ 12.3 in Table XII) was quite as tall as the nearby tall palms. However, the backcross palms had a distinctly greater girth than other palms of the same age.

TABLE XII

MEAN HEIGHT AND GIRTH IN DUMPY-BACKCROSS PROGENIES

Dumpy Parents	Height (in.)						Girth (in.)					
	Semi-Dumpy Parents				Mean	Semi-Dumpy Parents				Mean		
	12.3		14.2			12.3		14.2				
1.1	..	62	..	56	..	59	..	122	..	117	..	119
1.7	..	68	..	58	..	63	..	129	..	122	..	126
3.5	..	63	..	55	..	59	..	121	..	116	..	119
Mean	..	64	..	56	..	60	..	124	..	118	..	121
							Height (in.)		Girth (in.)			
Semi-Dumpy 10.8 × Semi-Dumpy 14.2							..	64	109			
Estate tall palms							..	66	109			

(ii) *Nutrition.*

256. Analyses have continued on the leaf samples collected from various estates for the nutrient survey and in addition samples have been taken from one 2⁴ (N,P,K,Mg) and one 2⁵ (N,P,K,Mg,Cu) manurial experiment. Samples were also collected from the experiment at Serdang where calcium and no-calcium manures are being applied. The effect of time of day of sampling has also been investigated on samples from Serdang. It has been reported that Dumpy palms have a higher magnesium requirement than tall and leaf samples were taken from one experiment where Dumpies and tall are being compared in a variety trial. This experiment consists of 48 plots and each plot was sampled separately.

257. In addition to analyses for N, P, K, Ca, Mg and ash, all samples have also been analysed for manganese and iron. The results of manganese determinations are of particular interest because it was found that while the average value for frond 17 in both upland and coastal soils was of the order of 200 to 300 p.p.m. Mn on a dry-matter basis, palms from two estates on peat had values of only 50 to 60 p.p.m. However, leaf injection and leaf spraying did not cure yellowed palms in one of these areas.

258. Another outstanding fact so far noted is that the ash content of the fronds from palms grown on coastal clays is often more than twice as much as that from palms on inland soils. The reason for this difference is unknown, but it makes it impossible to compare the nutrient content of fronds of palms on coastal and upland soils if comparisons are made on the ash basis. However, comparisons on a dry-matter basis are possible.

(iii) *Insect Pests.*

259. (a) *Cremastopsyche*.—The bagworm, *Cremastopsyche pendula* Joannis continued to cause widespread and severe damage to oil palms over a large area on two estates in Perak. As parasites have not checked this outbreak, experiments on insecticidal treatment are being carried out. Dusting with calcium arsenate has not proved effective against this pest so an experiment was laid down to compare BHC dust with DDT and dieldrin fogs. Results so far have been inconclusive, but the percentage of parasitised bagworms has remained as high in the treated as in the untreated areas. It has, therefore, been decided to continue with further insecticidal trials in the field, and other investigations into the life history and habits of this bagworm have been begun in Kuala Lumpur.
(Vid. par. 434.)

260. (b) *Orgyia*.—The leaf-eating caterpillar *Orgyia turbata* Butl. attacked oil palm seedlings on an estate in Johore. Dusting with BHC was not found to be effective and spraying with DDT was recommended for trial.

261. (c) *Oryctes*.—A very severe attack by the rhinoceros beetle *Oryctes rhinoceros* L. occurred on young oil palms planted on old rubber land on an estate in Perak. The larvæ were breeding in large numbers on the felled rubber and damage to the oil

palms was widespread. Control is being achieved by burning the rubber and hand collection of grubs and adults. (Vid. par. 272.)

(iv) *Diseases.*

262. (a) *Leaf Blight.*—*Curvularia* leaf blight of oil palm seedlings caused damage during the wetter parts of the year in several different areas. Some control of the disease can be obtained by spraying with a copper fungicide. A low concentration (0.1 per cent) of proprietary copper oxide or oxychloride formulations must be used on young seedlings to avoid scorching.

263. (b) *Leaf Spot.*—Leaf spotting, which occurred on two estates in Selangor, was caused by a species of *Melanconium*. This fungus was only found attacking old leaves and the damage done was slight.

264. (c) *Basal Stem Rot.*—This disease, caused by *Ganoderma lucidum*, has been much in evidence recently. One case of a young palm with the disease has been observed, but normally only palms of about 20 years or older are affected. In such palms, however, the percentage mortality can be high, up to 45 per cent having been reported from one area.

265. No economic method of preventing attack or detecting it in the early stages is known; control must, therefore, depend on prevention of the formation of fructifications, as the disease is spread by spores. In this connection, observations show that fructifications begin to sporulate two weeks after they become visible on the surface of the palm, so that to be fully effective, inspection rounds should be carried out at intervals of not more than two weeks.

266. (d) *Basal Stem Black Rot.*—A disease of unknown origin, in which the bases of young palms are affected by a dry, black rot, has been observed on an estate in Johore. The rot affects the whole base of the palm, which falls over, often while the leaves are still green. It is suspected that *Ustilina zonata* may be involved, but no fructifications of that or any other fungus have yet been found on diseased tissues.

3. COCONUTS

(i) *Breeding and Selection.*

267. A provision of \$25,000 for work on this crop has been made under the Draft Development Plan and equipment to be used in the controlled pollination of selected trees has been purchased. It has not yet been possible to commence this work due to shortage of staff.

268. Eighteen trees have been selected on an estate in Selangor, and it is hoped that controlled pollinations on them can be started almost immediately. Most of the large commercial coconut estates were visited during the second half of the year and arrangements were made to obtain estate-selected nuts for planting at the Federal Experiment Station at Telok Bharu, Perak, in due course. Observations on the male and female flowering

phases of dwarf coconuts have been continued but are not yet complete; so far the indication is that self-pollination normally occurs.

269. Collection of open-pollinated coconuts from the selected trees at the abandoned Port Swettenham Experiment Station continued throughout the year. Five of the 37 selected trees have stopped bearing, but from the remainder, 1,413 nuts were harvested and 1,014 nuts and 539 seedlings were sent to the Federal Experiment Station, Telok Bharu.

270. At this station, five variety trials have been designed and were partly planted. Complete planting at one time was not possible due to the restricted number of seedlings available, but all should be completed during 1957. Growth so far, even of the over-aged seedlings which were planted at the beginning, is good and there have been few casualties.

(ii) *Insect Pests.*

271. (a) *Chalcoscelis*.—Damage caused by the slug caterpillar, *Chalcoscelis albigitata* Snell, occurred over an area of 200 acres in the coastal area of Selangor. Treatment with dieldrin in a solution containing 1.5 per cent actual ingredient and applied with a "Micron" sprayer was, on the whole, effective. (Vid. par. 411).

272. (b) *Oryctes*.—Severe damage by the rhinoceros beetle, *Oryctes rhinoceros* L., occurred on coconuts adjacent to an area of felled rubber on the coast of Selangor. (Vid. par. 261, 445).

4. PINEAPPLES

(i) *Selection and Breeding.*

273. Botanical work on pineapples was restricted in 1956 due to staff shortages, but the following investigations are in progress.

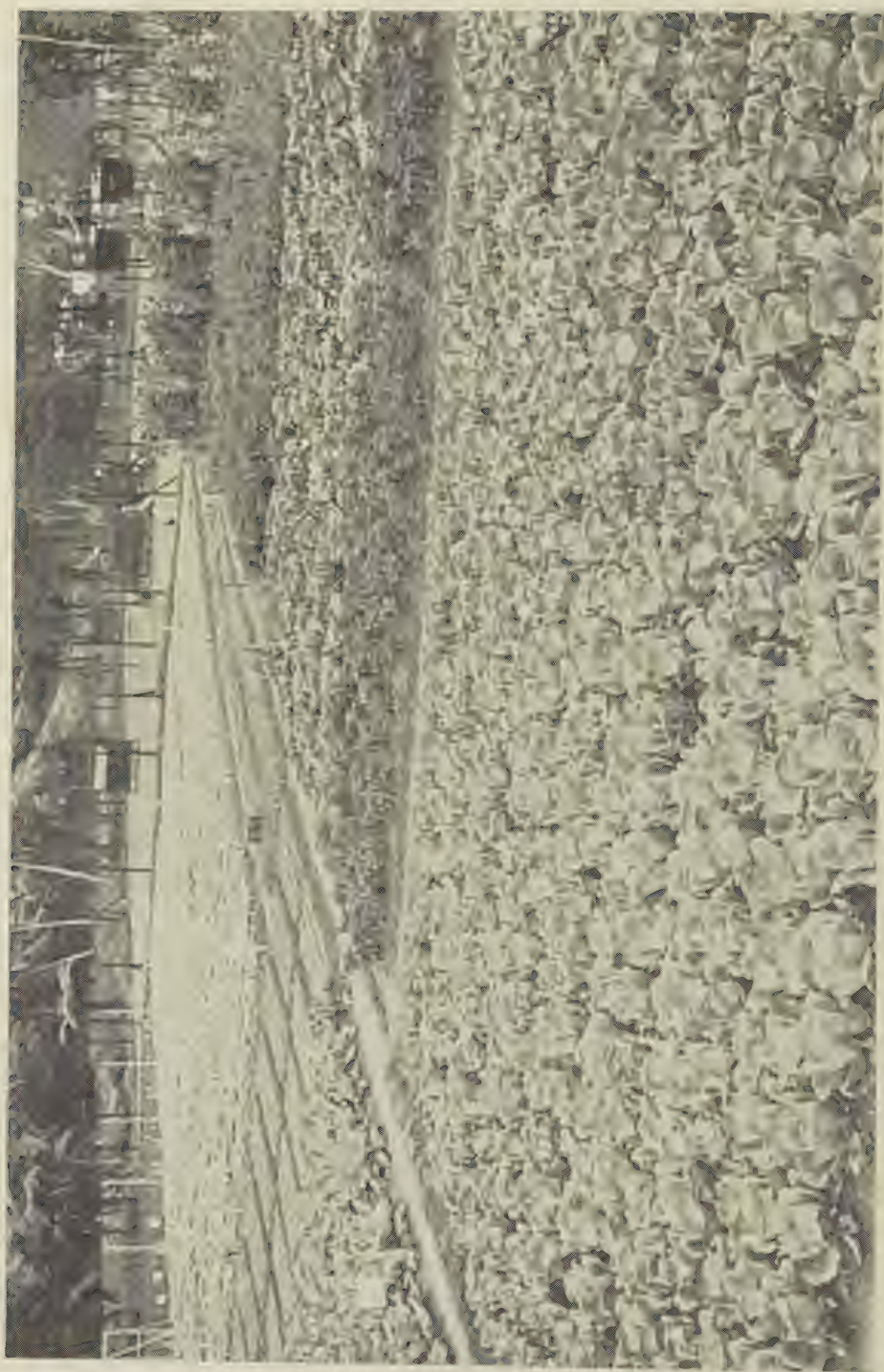
274. (a) *Singapore Spanish*.—Clonal selection of the Singapore Spanish variety at the Federal Experiment Stations at Jalan Kebun, Selangor and Alor Bukit, Johore. Fruit records at both sites were taken during the year and at Jalan Kebun, those of the second crop were almost complete. It should be possible, therefore, to replant with a reduced number of selected clones in the near future. Fruit records were also being taken from the mass selection plot of this variety at Jalan Kebun and superior clones will be included in the replanting mentioned above.

275. (b) *Sarawak*.—Clonal selection is continuing at Jalan Kebun and planting material of selected plants is being bulked so that each clone may be represented by at least six plants.

276. (c) *Smooth Cayenne*.—Observations and fruit recording are continuing at Alor Bukit in connection with clonal selection within Smooth Cayenne stocks imported from Australia and South Africa. Both of these varieties are now behaving very similarly to the Sarawak in producing very large fruits of poor canning quality, totally unlike those from the mother plants



Controlled pollination of a selected coconut palm.



General view of the mill and surrounding fields.

which were grown on the sandy soil of the quarantine station at Pulau Tekong, off Singapore.

277. (d) *Other Varieties*.—A collection of Malayan and introduced varieties has been established and two more species, *Ananas bracteatus* and *A. cochinchinensis*, were added during the year.

278. Four varieties from Taiwan were received during August. They are Typhone Nos. 1, 2 and 3, which are selections from Smooth Cayenne and Tainung No. 4, which was a Singapore-Spanish $\times$ Cayenne hybrid and is now used to a diminishing extent as a table variety. All these varieties are at present in quarantine and will be planted at Jalan Kebun on release. Arrangements have been made to import from Brazil a quantity of hybrid seeds and also some exotic species with desirable characters for possible use in breeding.

(ii) *Chemical Analysis and Quality*.

279. (a) *Nutrition*.—A total of 1,386 fruits were received at the Canning Research Station, Johore, from agronomic trials at Alor Bukit Experiment Station and 723 cans were put down for examination. The examination and grading of canned samples is continuing. A number of fruits from an experiment testing different quantities of potash fertiliser were canned in recent months and, though examination of these samples is not yet complete, results to date show that canned fruits from plots treated with potash have a much better flavour than those from controls.

280. (a) (i) *Potash*.—Chemical examination of pineapple fruits from the Federal Experiment Station, Jalan Kebun, harvested at the end of 1955 and in June, 1956, from Experiments Sel. 98 (quantity of potash) and Sel. 95 (type and method of application of potash) were completed.

281. Methods for the sampling of pineapple leaves were investigated and it was decided to take about the terminal one-third from the tip of the youngest fully grown leaf. About 25 to 30 such tips taken from plants which had neither flower nor fruit and which had received the same treatment constituted a samples. Leaf samples were taken from Experiments Sel. 98, Sel. 95 and Sel. 99 (magnesium and phosphate application). These were analysed for the elements nitrogen, phosphorus, potassium, calcium, magnesium, manganese and iron. A report on these experiments, bringing together the relationship between yield, quality of fruit and leaf analysis, will be published elsewhere.

282. With the Singapore Spanish variety, it was found that the yield, size and quality of fruit were related to the amounts of potash and phosphate in the leaves. The highest yield of good quality fruit was obtained when the potash-phosphate ratio in the leaves was approximately 14:1.

283. With the Sarawak variety, also, the highest yield was obtained when the potash-phosphate ratio in the leaves was approximately 14:1. The quality of fruit appeared to be independent of the ratio of potash to phosphate in the leaves.

284. The amount of nitrogen in the leaves of the Sarawak variety was less than that in the Singapore Spanish, and this variety did not respond to potash as well as the Singapore Spanish; it is probable that nitrogen was a limiting factor. Maximum yields could possibly be obtained from Sarawak by application of nitrogen and by applying sufficient potash and phosphate to give a potash-phosphate ratio of 14:1 in the leaves.

285. Leaf analysis shows that in both varieties the application of potash reduces the uptake of magnesium and phosphate. In the Sarawak variety, the amount of nitrogen in the leaves was also reduced.

286. In Experiment Sel. 95, testing the type and method of application of potash, the quality of the fruit was not affected whether potash was applied as the muriate or the sulphate. Nor was it affected when potash was applied in a ring round the plant or when mixed with five times its bulk of peat and placed in the outer leaf axil. The results of leaf analysis show that there was no difference in the uptake of potash by the plants whether muriate or sulphate was applied and whatever the method of application. In this respect, leaf analysis supports fruit quality examination. It is possible that the quantity of potash applied was insufficient to produce the optimum effect.

287. In this experiment a large increase in yield resulted from an increment of 20 lb. K_2O applied as sulphate, that is, an increase from 80 lb. K_2O to 100 lb. K_2O . Such a yield increase requires confirmation, as leaf analysis showed that there was little difference in the uptake of potash between the two applications.

288. (a) (ii) *Phosphate and Magnesium*.—Leaf analysis of samples from Experiment Sel. 99, testing effects of phosphate and magnesium application, showed that in the case of Sarawak and Singapore Spanish the application of phosphate increased the phosphate in the leaves, but the application of magnesium had not increased the magnesium content. It is probable that the application of a large basic dressing of potash with some nitrogen has tended to suppress the uptake of magnesium.

289. The yield of the Singapore variety was not affected by the application of phosphate or magnesium. There was possibly some yield response to the application of magnesium in the case of the Sarawak variety.

290. The analysis of leaf samples from the various experiments seems to indicate that leaf analysis could be used with advantage for fertiliser recommendations. Pending further investigation, it is tentatively concluded that for the Singapore Spanish variety maximum yields of good quality fruit should result if fertilisers are added so that the percentages of nitrogen, phosphorus and potassium in the leaf tips are: nitrogen (N), 1.2 ± 0.2 (on dry matter); phosphorus (P), 2.2 ± 0.3 ; and potassium (K), 32 ± 4 (on ash).

291. (a) (iii) *Deficiencies*.—Samples of distorted pineapple plants, resembling those described from Queensland as suffering

from "crook-neck", were received for test for zinc deficiency. Though it was not found possible to estimate the amount of zinc content, it was found that the magnesium content of the plants was very low. Samples of normal plants taken as controls from another but similar area showed that the copper content of the leaves was lower and the magnesium higher than in the affected plants.

292. (b) *Fruit Development*.—Pineapple fruits of the Singapore Spanish variety were harvested at various stages during their development and examined chemically. It was found that a marked change takes place in the percentage of total solids and total sugar about six weeks before the fruit is ready for harvest. Total acidity increases steadily with fruit development while pH falls steadily, and the percentage of potassium in the fruit increases as the fruit develops while those of calcium and magnesium fall.

293. (c) *Variety and Quality*.—The edible portions of pineapple fruits of the varieties Selangor Green and Mauritius were examined chemically. Mauritius was superior to other varieties in sugar and acid content. Selangor Green was very similar to Singapore Spanish (Table XIII).

TABLE XIII
ANALYSES OF FRUIT

Variety	Description	Total Solids %	Total Sugar %	Total Acidity* %	pH
Selangor Green	75% ripe ..	11.82	9.12	0.53	3.7
Mauritius	75% ripe ..	19.33	15.39	0.57	3.8

294. Leaf samples were taken from the two varieties Selangor Green and Mauritius and were analysed. Selangor Green gave results very like those of Singapore Spanish which had not received fertiliser. Mauritius had a higher potash content and a lower nitrogen content than Selangor Green (Table XIV).

TABLE XIV
ANALYSES OF LEAF TIPS
Means of Four Samples

Variety	% N	% Ash	% P	% K	K/P	% Ca	% Mg
Selangor Green ..	1.34	3.16	2.77	12.12	4.38	9.29	21.53
Mauritius ..	1.12	3.64	2.32	20.58	8.87	7.49	18.56

295. Considering the various varieties and the quality of fruit, especially the amounts of sugar and acid, a great deal seems to depend on the amount of nitrogen, phosphate and potash in the leaf. Since the amount of nutrients in the leaf can be altered by the addition of fertiliser, it means the quality of the fruit is to a great extent dependent on the type and quantity of fertiliser applied. When no fertiliser was applied, Mauritius and Sarawak had less nitrogen and phosphorus in their leaves than Selangor

* As anhydrous citric acid.

Green and Singapore Spanish. Under such conditions the first two varieties produced better quality fruit. Excessive amounts of nitrogen affect quality of fruit adversely. The amount of phosphorus in the leaf does not seem to influence fruit quality, but since it is supposed to influence the uptake of nitrogen to some extent, it has an indirect influence.

(iii) *Canning Research.*

296. (a) *Juice.*—Samples of canned pineapple juice from Australia, Hawaii and South Africa were analysed for comparison with similar Malayan products. The samples from some Malayan canneries were low in total solids, sugar and acidity as compared with those produced overseas (Table XV).

TABLE XV
ANALYSES OF PINEAPPLE JUICE

Source		Specific Gravity	Total Solids %	Total Sugar %	Total Acidity* %	pH	Ash
Foreign	..	1.060	16.84	12.92	0.80	3.49	0.40
Malayan A	..	1.037	9.28	7.60	0.64	3.73	0.39
Malayan B	..	1.041	10.92	9.02	0.56	3.63	0.30

297. A number of experiments have been carried out at the Canning Research Station, Johore, to explore the possibility of using filtered juice as a base for preparation of canning syrup and to prepare juice in a concentrated form for shipment abroad.

298. (1) *Filtered Juice.*—Juice as received from the canneries contains up to 10 per cent sugar. It was found that pumping juice through a double layer of G.S. "Sterimat" filter pads gave a clear product. The juice should be pasteurized and centrifuged prior to filtration to remove as much of the suspended solids as possible in order to prolong the life of the filter pads.

299. The removal of the cloudiness from the juice also takes away some of its flavouring constituents and gives a product with a taste different from normal pineapple juice. Extra sugar was added to this to make the syrup used for canning pineapple. The canned product, also, had this unusual taste which was thought to be associated with the increased acidity of the pack.

300. Experiments were then carried out on the neutralization of different amounts of the acid in the filtered juice. The pH of local juice is around 4.0 and it was found that best results were obtained by reducing the acidity to pH 5.0; calcium carbonate was used as the reagent for this. This partially neutralized juice, when used as a canning syrup with the addition of sugar, improved the flavour of canned pineapple.

301. The removal of the cloudiness from juice appears to enhance its golden colour. Canned pineapple products using filtered juice as a base for the syrup show a marked improvement in colour. The advantages of using filtered juice as a base

* As anhydrous citric acid.

for canning syrup may, therefore, be summarised as giving a saving in sugar and improvement in colour, acidity and flavour of canned pineapple.

302. (2) *Concentrated Juice*.—The Mojonner Lo-Temperature Pilot Plant Evaporator arrived in July, 1956, and most of the work of setting it up was done by the staff at the Canning Research Station. Thanks are due to Messrs. Singapore Cold Storage Co., Ltd., for the loan of a Refrigeration Engineer to get the ammonia-compressor section working. The station's Junior Laboratory Assistant is now trained in the operation of this complete unit.

303. All juice used for experiments comes from the local canneries. Trials were carried out on evaporation of the juice to different degrees of concentration. It was found best to evaporate to 60° Brix and then dilute this to 44° Brix with fresh juice. At 44° Brix the product is sufficiently fluid for rapid sterilization and for packing into cans. This is almost a five-fold concentration in which the acidity is up to 3 per cent and the product requires a heavily lacquered can. A supply of these cans has now arrived and batches of concentrate will be prepared for shipment abroad for market appraisal. This latter work has been held up temporarily due to strikes at local canneries.

304. This 44° Brix concentrate may be diluted with water to suit the customer's taste. We find that dilution to 12.5° Brix gives a product comparable with that produced in other countries where better quality fruit is used.

305. Before concentration, it is necessary to centrifuge the juice to reduce considerably the suspended solids which otherwise tend, during the evaporation of the water, to give an immobile mass which slows up the whole process.

306. The possibility of evaporating filtered juice to 30° Brix for use as a canning syrup has been considered. Some experiments have been done but, as previously explained, it was found that although filtered juice is rich in colour, upon evaporation to 30° Brix for canning syrup it gives a brownish product which would spoil canned fruit. Special carbon-mat filter pads are on order for future experiments in the removal of some of the discolouring impurities. The use of ionization would probably be necessary to produce a colourless and tasteless syrup from juice; whether it would be economical to use this process on a juice with low sugar-content is very doubtful.

307. (3) *Can Staining*.—Reports have been received that can staining was due to the presence of sulphur compounds in the juice. Tests show that the canning sugars are free from sulphur compounds, but the juice did give some positive reaction. The presence of glutathione in pineapple is suspected as a possible source of the contaminant which causes staining.

308. (b) *"Paraffin" Flavour*.—As a result of work reported in the Annual Report for 1955, it was arranged that a local company would pack each month for a whole year about 800

cans of fruit from two selected areas and that these cans would be opened and examined by staff of the Department for paraffin flavour. This experiment has not progressed as well as was expected, due mainly to scarcity of fruit in the selected areas during certain periods of the year and to labour unrest at the plantations and canneries. The only months in which tests were completed were September, October and November, 1955, and January, 1956. During 1957 efforts will be made to complete the experiment for the other missing nine months. Of the cans already packed, 300 have been examined and the fruit in only one can showed slight paraffin flavour.

309. (c) *Syruping*.—A series of experiments was carried out to find the advantages, if any, of mechanical exhausting as compared with the heat exhausting now practised in the canneries. Glass packs of Singapore Spanish, Golden, Standard and Sub-standard grades were put down. Nine lots of each were packed. The fruit was held under 23 in. vacuum for periods ranging from 30 sec. to 13 min. and the syrup was added while the fruit was still under vacuum. It was shown that fruit held under mechanical vacuum of 23 in. for 1 min. showed an improvement in colour and an increase in drained weight when compared with heat-vacuumised controls. This was due to removal of white flecks and replacement of air pockets with syrup. Cans were examined after nine months storage and the improvement in colour due to the use of mechanical exhausting was very pronounced, particularly in the Standard and Sub-standard grades.

310. Samples of fruit have been packed with syrup prepared with "Permutit" treated water together with samples containing syrup made with tap water as controls. These will be examined after a period of storage for the effects, if any, of trace elements in water on the staining of tin-plate.

311. (d) *Fruit Maturity*.—During the year, a number of laboratory tests were carried out to see if the skin colour is a true indication of the chemical maturity of the fruit. The fruit for these experiments came from Alor Bukit Experiment Station and was examined within 24 hours of harvesting. For practical purposes, the soluble solids or degrees Brix indicate the amount of sugars present. The soluble solids divided by the titratable acidity give a figure which is known as the maturity ratio. Table XVI shows that there is a relationship between the skin colour and the chemical maturity.

TABLE XVI
RELATION OF PINEAPPLE COLOUR AND MATURITY

Skin Colour						$\frac{\text{Soluble Solids}}{\text{Acidity}} = \text{Maturity}$
Grey Bracts	..	..	..	..	..	14.32
25% Red Eyes	..	..	..	..	..	14.70
50% "	..	..	..	..	..	15.22
75% "	..	..	..	..	..	15.88
100% "	..	..	..	..	..	20.83

312. (e) *Varietal Differences*.—An investigation was carried out to compare the qualities of the canned products from four local varieties. Results showed little difference between Selangor Green and Singapore Spanish, but the latter was favoured slightly. The Mauritius variety was remarkable for the bright golden colour of its products over a wide range of fruit maturity, as compared with the other three varieties. The fruit is small and, apart from its colour, has nothing to recommend it for canning. Sarawak was inferior in both flavour and colour. All four varieties were at their best for canning when 50 to 75 per cent ripe, as judged by skin colour.

313. A preliminary investigation of the same four varieties to determine the recovery of total edible matter, as canned slices or segments and juice, again showed little difference between Singapore Spanish and Selangor Green. Mauritius and Sarawak gave only about a third as much crushable material (4.5 per cent of fruit weight) as the other two varieties and wastage in canned fruit was greatest with Sarawak, owing to its large core-diameter and excessive bruising in the sample tested.

(iv) *Insect Pests*.

314. (a) *Mealy-Bugs*.—The field trial in connection with mealy-bug wilt to discover whether plants could be kept free of mealy-bugs by fumigation of planting material and periodic spraying with insecticide has been continued. The mealy-bug population in the treated plots was lower at first and growth of the plants in the treated plots was greener and more vigorous. However, this difference has now, about a year and a half after planting, disappeared. Failure to prevent mealy-bug invasion of the treated plots is thought to be due to too-infrequent spraying and rapid inactivation of the insecticide (dieldrin) used on the peat soil.

315. Two further pot trials and a small field trial to investigate the cause of mealy-bug wilt were begun in Kuala Lumpur.

(v) *Diseases*.

316. (a) *Heart Rot and Fruit Collapse*.—Fruit collapse, previously found only in Johore, has now been recorded in Perak. Heart rot has also been found in Perak and in a previously unaffected area in Selangor (the Federal Experiment Station, Jalan Kebun).

317. The bacterium causing both these diseases has been identified as a strain of *Erwinia carotovora*, a species which causes a soft rot of carrots, brassicas, etc. To discover whether strains attacking vegetables could also attack the pineapple, isolations were made from pak choy (*Brassica chinensis*) and lobak (*Raphanus sativus* var. *hortensis*). These did not produce disease symptoms when inoculated into pineapple, so it would appear that the pineapple strain is a specialised one.

318. In an experiment on the control of heart rot, neither Bordeaux mixture nor streptomycin sulphate, when sprayed at

intervals of ten days, resulted in a significant reduction in the number of plants attacked by the disease.

319. A hitherto unrecorded type of bacterial disease occurred on specimens received from an estate in Johore. Leaves were attacked as in typical heart rot but the plants were bearing fruit and the rot had extended into the base of the fruit stalk. Isolations proved that the disease was caused by the same species of *Erwinia* that causes normal heart rot and the specimens are therefore regarded as a typical examples of this disease.

5. CACAO

320. Work on cacao during the past year has been marked by a very considerable expansion in the volume and scope of breeding work for the production of higher yielding varieties of good quality. The initial difficulties of processing have been overcome and most of the types under trial have proved capable of producing a chocolate of acceptable quality. With the extension of planting in new areas, nutritional problems have come more to the fore but have so far presented no insuperable difficulties, and with the earliest plantings approaching maturity, closer attention has been paid to potential disease and pest problems and their control.

321. Yields at the Federal Experiment Station, Serdang, have fallen off considerably during the past year. Last year, it was reported that the disparity between autumn and spring peak crops was much reduced. This trend continued during 1956 and the trees in field 47A yielded more pods in October than any field in any other month of the year.

322. Yields from the Upper Amazon trees in field 50 at Serdang have fluctuated less than those of varieties in other fields and the annual crop is nearly double that of 1955. This and field 47 are the only two fields showing an increase in yield from 1955 to 1956.

323. The method used in 1955 of eye-scoring each field at fortnightly intervals for degree of flushing was continued during 1956. From these scores, it appears that flushing at no time reached as high a general intensity as it did in September, 1955. This can be explained by the prolonged dry spell which was experienced during June and July, 1955, but not in 1956.

(i) Selection.

324. (a) *Technique.*—(1) *Crop Forecasting.*—This year's attempt to forecast crops from an eye-score of quantity of cherelles was as unsuccessful as the previous years' attempts using flowering intensity as a guide.

325. (a)—(2) *Crop Recording.*—Varietal plot yields are usually calculated as the sum of yields from individual trees. Individual tree yields are taken as the product of the number of pods harvested and the mean weight of fresh cacao per pod. The mean weight of fresh cacao per pod for each tree is determined from one sample of 15 pods. It is clear that while this method

of computing yield gives information useful for individual tree selection, it is unnecessarily tedious when only "yield per plot" is required. In view of the numerous progeny and clonal trials now established at Federal Experiment Stations, two other methods of yield recording have been investigated in the trial of Indonesian Trinitario at Serdang.

326. *Yield of Pods and Fresh Cacao per Plot.*—Plot boundaries were clearly marked in the field with concrete corner posts. After the number of pods harvested from each tree had been recorded in the usual way, all the pods in each plot were collected and opened together. When the pods were opened, those found to be rotten or over-ripe were discarded. The number of good pods and weight of fresh beans per plot were recorded at each harvest.

327. These "plot" figures give the actual yield of fresh beans per plot and so may be preferred to the ones based on calculated yield per tree. Both sets of figures are given in Table XVII. While differences between actual and calculated yields are appreciable, they make no real difference to the relative value of the progenies under trial and indicate that either method of recording may be used, as convenient.

328. Since actual yields are greater than calculated yields, it must be presumed that, on the average, trees yield more cacao per pod than is indicated by the samples of 15 pods which were analysed. This is not unexpected, since the sample of 15 pods was taken as soon as the trees came into bearing and the weight of cacao per pod should increase slightly as the trees mature. It is intended that more analyses of 15-pod samples should be carried out as the trees mature.

TABLE XVII
YIELD OF FRESH CACAO PER ACRE IN 1956
(lb.)

Variety	Calculated Yield	Actual Yield	Calculated Yield as % of Actual Yield
Trinitario A	2,113	2,148	98
.. B	2,130	2,363	99
.. C	1,835	2,055	89
.. D	1,865	1,878	99
.. E	2,143	2,373	90
Amelonado F	2,300	2,378	97
Mean	2,064	2,199	95

329. By recording the weight of fresh cacao from a known number of pods at each harvest, it has been possible to follow the general variation in pod value through the year. There is evidence that bean size is positively correlated with weight of beans per pod and a study is being made of the effects of season on yield and on pod characteristics and number.

330. *Yield of Pods Determined by Counting While Still on the Tree.*—The method described by Jolly (*A Report on Cacao Research*, 1945-51) and tested at Serdang since 1955, based on

quarterly counting of all pods likely to mature within three months and marking the smallest counted, has so far revealed that some trees may lose up to 80 per cent of the counted pods during the following three months and that on the average some 30 to 40 per cent of the pods are lost. There is little doubt that most of those losses are due to rodents, monkeys, etc., and immature low-yielding trees tend to show a greater percentage loss than high-yielding trees; it may well be that so long as pest damage occurs this method should be restricted to high-yielding, mature trees. In addition, it has been noticed that pods borne on the trunk often grow faster than those borne on branches and may therefore be missed in counting. Reducing the interval between counts to two months and marking all pods would be laborious and defeat the object of the exercise.

331. There is evidence that some varieties lose more pods than others, that most pods are lost in the fifth to sixth month, and that the time taken for pods to mature varies with the season. Results are still being perused and the experiment continues.

332. (b) *Amelonado*.—The *Amelonado* seed garden at Serdang has given very poor yields during the year. The autumn crop from the seed garden in field 44A was poor and this, following a poor spring crop, has reduced the annual yield almost to the 1953 level. Despite the prevalence of "die-back" in this field, there are indications that the low yields may be due to some nutritional disorder. The performance of comparable *Amelonado* growing elsewhere on the station tends to confirm that the material itself is not at fault.

333. (c) *Trinitario*—(i) *Indonesian*.—The Latin square trial of five *Trinitario* progenies and one *Amelonado* control planted in 1950 at Serdang continued to yield extremely well. The assumed recovery rate of 40 per cent for all varieties tends to favour the *Trinitario* varieties but, even so, they are still yielding less than the *Amelonado* (Table XVIII).

TABLE XVIII
PROGENY TRIAL COMPARING INDONESIAN TRINITARIO AND
AMELONADO

(Expt. No. C. 6 F.E.S.S. 115. Planted Sept., 1950)

Yield of Dry Cacao per Acre

(assumed 40% recovery)

(lb.)

Variety	1954	1955	1956	Mean
A. Getas 8	317 ..	636 ..	843 ..	599
B. Djaterongo 1	352 ..	763 ..	850 ..	655
C. Poerboyo Red	384 ..	647 ..	733 ..	588
D. Poerboyo Green	348 ..	578 ..	745 ..	557
E. Suzann edaal	485 ..	776 ..	856 ..	706
F. <i>Amelonado</i> (from Celebes Islands)	543 ..	853 ..	917 ..	771
M.S.D. at 5% pt.	199 ..	223 ..	N.S. ..	N.S.

334. (c)—(2) *Malayan*.—Yields in 1956 from this progeny trial at Serdang were disappointing; all varieties gave less than in the previous year. Even at the favourable recovery rate of 40 per cent, the Trinitario varieties are still yielding considerably less than Amelonado. The 1955 figures suggested that the near-Criollo varieties might yield as much as Amelonado in 1956, but this has failed to be the case; the years-varieties interaction variance is significant at the 5 per cent point (Table XIX).

TABLE XIX

MALAYAN TRINITARIO

Yield of Dry Cacao per Acre

(assumed 40% recovery)

(lb.)

Variety	1954	1955	1956	Mean
Amelonado	353 ..	452 ..	308 ..	371
Near-Criollo Trinitario	201 ..	412 ..	265 ..	293
Other Trinitario	145 ..	280 ..	172 ..	199
M.S.D. at 5% pt.	51 ..	49 ..	N.S. ..	N.S.

335. (c)—(3) *West African*.—The number of pods harvested from the WACRI (West African Cacao Research Institute) progenies in field 49A at Serdang was considerably higher than last year. This is partly due to an increase in the number of pods formed but mainly because of the measures taken to protect them from rodent damage.

336. (c)—(4) *New Guinea*.—Despite thinning of the overhead *belukar* (secondary forest), shade and fertiliser applications, growth and yield, particularly of these strains, remained poor at Serdang. Fifty-two trees were selected, principally on pod characteristics, for propagation in the second preliminary clonal trial at the Federal Experiment Station, Jerangau, Trengganu.

337. (c)—(5) *Samoa*.—Only one small cutting of the Samoan “Criollo” type of “Lafi 7” survives from a consignment of three cuttings received from Kew in September, 1956.

338. (c)—(6) *Trinidad*.—A small plot of ICS 1* seedlings planted in 1951 in field 47A at Serdang has shown some improvement this year, but unselected buddings from them in an adjacent plot are still very poor (Table XX).

TABLE XX

YIELD OF SEEDLINGS AND BUDDINGS OF ICS 1

	No. of Plants Alive	Mean Wt. of Fresh Cacao per Pod (gm.)	Mean Fresh Bean Weight (gm.)	Yield of Dry Cacao per Acre (assumed 40% recovery) (lb.)			
				1953	1954	1955	1956
Seedlings	25	124	3.5	48	353	294	780
Buddings	23	117	3.5	0	26	204	232

* ICS = Imperial College Selection.

339. Seedlings of ICS 1, 7 and 9, planted in 1951 in a different field (49A), have given a negligible yield and it is likely that this material will never yield well so long as soil fertility remains low and rodent damage high.

340. ICS 8 and 84 were included in a consignment of cuttings received from Kew in September, 1956. This brings the total number of ICS clones now in Malaya to twelve: viz. ICS 1, 6, 8, 16, 39, 40, 45, 60, 84, 89, 98 and 95.

341. Since earlier ICS introductions growing in the Serdang ICS budding and cutting-wood nursery were not required to produce wood this year, they were allowed to form pods. The yields and pod quality were very good (Table XXI).

TABLE XXI
ICS CLONES IN NURSERY

Clone	No. of Plants Bearing	No. of Pods in 1956	Mean Weight of Fresh Beans per Pod (gm.)	Mean Fresh Bean Weight (gm.)	Mean Dry Bean Weight (Micro-fermentation) (gm.)
6	10	33	210	4.8	—
39	9	31	160	4.5	1.6
40	9	34	180	4.7	—
45	9	10	130	5.2	—
60	9	75	190	4.6	1.9
89	9	57	180	4.7	1.8
95	9	70	130	3.4	1.0

342. (c)—(7) *Grenada*.—Cuttings of clones GS 29 and GS 36 were imported from Grenada via Kew in September, 1956.

343. (d) *Upper Amazon*—(i) *Progenies*.—The small plot of 39 seedlings planted in October, 1952, at Serdang continues to yield well (Table XXII).

TABLE XXII
UPPER AMAZON
Accumulated Yield of Dry Cacao per Acre
(assumed 40% recovery)
(lb.)

	Months from Planting						
	18	24	30	36	42	48	60
Upper Amazon	2	82	318	383	662	878	—
Amelonado (mean from 3 fields) ..	1	2	2	22	109	291	735

344. "Leaf-axil spot" is not to be found on true Upper Amazon trees and so the seven Serdang seedlings showing this characteristic are most probably Upper Amazon × Trinitario hybrids. Trees with leaf-axil spots are at present inferior to the others in yield and pod quality (Table XXIII).

TABLE XXIII

UPPER AMAZON

Accumulated Yield at Four Years

	Lb. of Dry Cacao per Acre (assumed 40% recovery)	Fresh Cacao per Pod (gm.)	Fresh Bean Weight (gm.)
5 trees in bearing with leaf-axil spot	455	92	2.5
29 trees in bearing without leaf- axil spot	1,042	109	2.7

345. Controlled and open-pollinated seed from selected Upper Amazon trees was used to plant 20 acres on an estate in Trengganu this year. A large proportion of the planting could be used as a form of progeny trial. Seedlings showing a leaf-axil spot were identified in the nursery and planted in one small block where they can be conveniently replaced if found to be low-yielding.

346. Seedling Upper Amazon stocks have been planted in an isolated area on the same estate in Trengganu and will be bud-grafted in 1957 with wood from selected trees at Serdang. This seed garden cannot be used for statistical comparisons of the clones since they are arranged systematically, but it may nevertheless give some useful information.

347. (d)—(ii) *Clones*.—Three Upper Amazon clones, IMC 60, IMC 76 and Na 33, imported from Kew in 1955, flowered soon after being established in the Serdang cutting-wood nursery. They were used to pollinate three of the best Upper Amazon seedlings at Serdang and the progenies are to be planted in a small trial at Jerangau in 1957. In this way, it is hoped to gain some advance information on the potential value of the original clones in Malaya.

348. The 1955 consignment of Upper Amazon clones was followed by another in September, 1956. The clones now represented at Serdang are: IMC 60 and 76; Nanay 31, 32, 33 and 34; and Parinari 7 and 35. These eight clones include the parents of nine out of the ten approved WACRI lines.

349. (e) *Selection Trials*.—(1) *ICS Clones*.—Preparations for planting a clonal trial of eight ICS clones (6, 16, 39, 40, 45, 60, 89 and 95) at Jerangau are well advanced. They will be tested as buddings and cuttings against a control of Amelonado seedlings. The buddings are to be grafted onto both Amelonado and Upper Amazon seedling rootstocks.

350. (e)—(2) *Other Trinitario*.—Following a dressing of magnesium-limestone and the regeneration of jungle growth, giving lateral shade, the buddings in the first clonal trial established in 1955 at the Federal Experiment Station, Jerangau, Trengganu, have grown satisfactorily. No records are available yet.

351. The second preliminary clonal selection trial at Jerangau was budgrafted in September, 1956, and follows the same design as the first—two replications with six plants per plot in each. The 90 Trinitario clones under test are:

	No. of Clones
Local Trinitario	18
Indonesian Trinitario	10
WACRI Trinitario	42
ICS Trinitario	2
ICS (F ₁) Trinitario	8
New Guinea Trinitario	10

These were interplanted with ten Amelonado control plots at regular intervals. ICS 95, which was represented in the first trial, is also included in this trial to serve as an additional control to the Amelonado.

352. (e)—(3) *Upper Amazon*.—Though some of Pound's original Upper Amazon clones have recently been imported (para. 347), F₂ seedlings from these clones were planted at Serdang in 1952. The growth of these seedlings has been so good that it has been decided to establish a clonal trial at Jerangau from the best thirteen plants. The Serdang seedlings will be tested as clones, using buddings and cuttings, with buddings on both Amelonado and Upper Amazon rootstocks. An Amelonado control is omitted from the trial, since it may be desirable to use the trial as a seed garden in the future. A subsidiary trial will be established to test the relative value of Amelonado and some of these clones.

(ii) *Breeding*.

353. (a) *Compatibility*.—Ten or more controlled pollinations of certain self-compatible and self-incompatible trees carried out every month during the year have failed to demonstrate any general periodicity in the intensity of fruit setting. Only in one month was there any suggestion that one self-compatible tree was, for the time being, self-incompatible and, by the method used, no self-incompatible tree ever set fruit after self-pollination.

354. (b) *Hybrids—Amelonado × Nanay*.—Despite the low soil fertility in field 45 at Serdang and despite a number of casualties, a few hybrid trees grown there have recently formed cherelles and are clearly more vigorous than the interplanted Amelonado controls. Girth measurements taken in December, 1956, showed that the mean girth of the Amelonado plants at 4 in. from the ground was 8.5 cm. while the hybrid mean was 11.0 cm.; the difference is significant at the 1 per cent point.

355. (c) *Progeny Selection—(1) Main Blocks*.—It was originally planned that 90 different hybrid progenies would be planted at Jerangau in a series of trials by mid-1956, and 11 acres

were allocated for this purpose. For various reasons, the programme will be only partly complete by mid-1957. It is fortunate that progeny trials of West African Trinitario were delayed, since the land intended to accommodate them has only recently been found to be liable to flood during periods of very heavy rain.

356. The slightly modified and reduced programme for six progeny trials at Jerangau is summarised in Table XXIV. Thirteen progenies and one West African Amelonado control are to be planted in each trial. Progenies A and B could be obtained by open-pollination of clones in a seed garden, but progenies C would require hand-pollination and are only included lest A and B produce too many self-incompatible trees.

TABLE XXIV
NUMBERS OF PROGENIES IN TRIALS

Trial No. Planting Dates	I Nov., 1955	II May, 1956	III Aug., 1956	IV Nov., 1956	V Jan., 1957	VI Aug., 1957	Total
(A) S.I.* Parent × S.I. Parent							
Upper Amazon × Upper Amazon	—	2	10	3	2	3	20
Upper Amazon × S.I. Trinitario	3	2	—	4	4	2	15
(B) S.I. Parent × S.C.† Parent							
Upper Amazon × S.C. Trinitario	—	2	—	1	—	—	3
Upper Amazon × Amelonado	1	2	—	1	—	1	5
Upper Amazon × Criollo ..	1	1	1	—	1	—	4
S.I. Trinitario × Amelonado	3	1	—	—	—	1	5
S.I. Trinitario × S.C. Trinitario	2	2	2	3	5	3	17
(C) S.C. Parent × S.C. Parent							
S.C. Trinitario × Amelonado	1	—	—	1	1	2	5
S.C. Trinitario × S.C. Trinitario	2	1	—	—	—	1	4
Total ..	13	13	13	13	13	13	78

357. In the first progeny trial, planted in November, 1955, growth continues to be excellent and only three of the 840 plants in the trial have died. As this trial is one of six which are being planted to determine the best "type" of cross rather than the best individual parent tree, it is important to note from the growth measurements given in Table XXV that differences in height to jorquette and girth between "types" of progenies are not outstanding unless height/girth ratios are considered. Then the differences between types are far greater than those within types and it may be provisionally concluded that the type of pedigree determines the shape of a tree rather than its actual size.

* S.I. =self-incompatible.

† S.C. =self-compatible.

TABLE XXV
GROWTH MEASUREMENTS TAKEN TWELVE MONTHS AFTER
PLANTING

Progeny	Type of Pedigree*	Height of 1st Jorquette from Ground (cm.)	Girth of Plants with Jorquette (cm.)	Height/ Girth Ratio	Percentage of Plants with a Jorquette	Girth of all Plants (cm.)
A	Amelonado (Control)	126	9.0	14.1	95	8.9
B	S.I. Trinitario × S.C.	124	8.5	14.5	85	8.0
C	Trinitario	110	8.3	13.3	90	8.3
D		133	8.5	15.6	77	8.0
E	S.I. Trinitario × Ame-	129	9.0	14.6	92	8.8
F	lonado	134	8.8	15.3	93	8.7
G		117	9.3	12.5	93	9.3
H	S.I. Trinitario × Up-	136	10.3	13.3	100	10.3
J	per Amazon ..	116	9.1	12.7	95	9.1
K	Criollo × Upper					
	Amazon	119	9.4	12.8	98	9.4
L	S.C. Trinitario × S.C.	128	8.9	14.4	85	8.6
M	Trinitario	135	8.7	15.4	92	8.5
N	S. C. Trinitario ×					
	Amelonado ..	125	8.6	14.5	92	8.5
P	Upper Amazon ×					
	Amelonado ..	122	9.1	13.4	97	9.1
M.S.D. at 5% ..		14	N.S.	1.5	12	N.S.
F test "between 8 types" ..		N.S.	N.S.	Sig. at 0.1% pt.	Sig. at 1% pt.	Sig. at 5% pt.
F test "within types" ..		Sig. at 5% pt.	N.S.	N.S.	Sig. at 1% pt.	N.S.

358. The correlation ($r = + 0.83$) for progenies between girth of all plants and percentage jorquetted plants is significant and positive. The correlation ($r = + 0.67$) remains when girth at six months is used, instead of girth at 12 months, which suggests that large girth is the cause and not the effect of jorquetting which does not occur within six months of planting. No correlation ($r = - 0.16$) appears to exist between progeny height and percentage of plants jorquetted.

359. The second trial was planted with progenies of widely different ages. Some seedlings had been in the nursery for more than three months longer than others. Each of the Amelonado control plots was therefore planted with seedlings from six to ten months of age and growth measurements taken six months after field planting showed that the age of seedlings at planting had a significant effect on the size of plant in the Amelonado plots at that time. Correlations between age at planting and growth at six months of the other progenies have not yet been examined, so that the apparent vigour of the two Amelonado × Upper Amazon hybrids in this trial remains to be confirmed. Three more progeny trials had been planted in this block by the end of the year and, in addition to the progeny selection block, three other small blocks are now planned.

360. (c)—(2) *Inbreds*.—Ten of the most promising Trinitario trees or clones at Serdang have been self-pollinated and 58 seedlings of each progeny will be planted in an unreplicated one-acre block at Jerangau. The main purpose of this planting is to obtain improved self-compatible clones, but a block of Trinitario cacao with a very high proportion of self-compatible trees may also be useful for pollination studies, etc.

* S.I. self-incompatible; S.C. self-compatible.

361. (c)—(3) *Criollo-Types*.—Although at present in Malaya yield is of paramount importance, provided that quality is acceptable to the manufacturer, it is considered that quality improvement should not be ignored. Accordingly, a one-acre block of seedlings is to be planted at Jerangau in 1957 with ten progenies all derived from Trinitario trees with Criollo-type beans. This should provide a foundation of material for selection and yield sufficient beans to carry out fermentation tests of this type.

362. (c)—(4) *Upper Amazon Backcross*.—Serdang F_2 seedlings crossed with the original clones are to be planted in another one-acre block, as described in paragraph 361.

363. (c)—(5) *Seed Gardens*.—An area has been prepared at the Federal Experiment Station, Jerangau, in which it is intended to establish in 1957 a nursery of 30 plants of each of the clones used or likely to be used as parents for progeny trials at Jerangau. Should any of these clones be required in a few years time for establishing seed gardens, the material will be available from this nursery. Excluding the ICS clones, 53 clones have been selected for this purpose to date.

(iii) *Processing*.

364. (a) *Microfermentation*.—In the Chemistry Division fermentation of the cacao from single pods of selected trees has continued. Very few have produced unsatisfactory chocolate and with these the processing itself was substandard.

365. During the year, 23 microfermentations were carried out. No unusual flavours have been detected in the resulting chocolate. The technique used seems satisfactory; the slowest stage is the milling of nibs and chocolate, since the mill has to be cleaned between samples.

366. Only minor modifications of the technique reported last year have been made. It has been found that for ripe Trinitario or Amelonado beans, fermentation for four days at 35° C. followed by fermentation for three days at 50° C. is satisfactory. This is now the routine fermentation procedure. Turning, aeration, or the use of KOH makes no difference to the flavour, but daily turning controls mould growth and gives a better appearance to the cured cacao.

367. Fermented beans are washed, so that varying amounts of adhering pulp do not distort the yield and shell figures. As this gives lower dry-yield and shell-percentage results than commercial type curing, in which the beans are not washed, an estimate of the differences between results for washed and unwashed beans was made. Apart from its use in laboratory work, washing is not desirable as it tends to make the shells brittle.

368. It was thought at first that the stage of ripeness had some connection with the number of split testae which were found after fermentation, but there were no split testae in the beans of a second set of pods. Since then, it has been noticed that

testae are sometimes split in fresh beans in the pod. It may be possible that these splits develop during fermentation, but fresh-bean splits were not counted because they were not easily seen under the opaque pulp. Splitting is important because split beans more often become mouldy.

369. (b) *Chocolate Preparation*.—One set of beans fermented at different stages of ripeness has been tested. No great difference in chocolate strength was noticed; the flavour varied steadily from “caramel” in the under-ripe cocoa to a sharp, light taste in the over-ripe. The under-ripe was the more palatable.

370. Attempts to describe or to give a numerical rating to chocolates have proved of little use. This accords with experience elsewhere.

371. So far no unacceptable flavour has been detected among the routine fermentations; nor, on the other hand, has any impression of outstanding quality been made by five commercial samples of cacao from abroad. It is difficult to determine whether a cacao which makes a palatable test-chocolate is suitable for use by the manufacturers. The best that can be done is to detect specimens with undesirable flavours.

372. Much of this work on cacao processing has been carried out with the advice and collaboration of Messrs. Cadbury Bros., to whom the Department is indebted for their very considerable assistance.

373. Fermentation of pulasan seed (*Nephelium mutabile*) and subsequent processing yielded a substance very similar to chocolate in appearance, texture and flavour. Rambutan seed (*N. lappaceum*) fermented similarly but, unlike pulasan, required addition of fat for further processing. (Vid. par. 408 *et seq.*)

(iv) *Insect Pests*.

374. (a) *Apogonia*.—An experiment at the Federal Experiment Station, Serdang, to compare different insecticides applied as foliage sprays against *Apogonia* spp. was completed near the end of 1956. Lead arsenate (0.4 per cent solution) and 25 per cent DDT miscible liquid (0.08 per cent) appeared to give better control than dieldrin (0.3 per cent) or 50 per cent DDT wettable powder (0.2 per cent).

375. (b) *Helopeltis*.—*Helopeltis theobromae* Miller caused considerable die-back on young cacao in Trengganu. A proposed experiment to compare the effectiveness of different insecticides in the control of this insect has been delayed by unfavourable weather, but it is hoped that the trial can be started early in 1957. *Helopeltis* on cacao at the Federal Experiment Station, Serdang, has been effectively controlled by fogging with DDT and in Pahang by fogging with dieldrin.

376. (c) *Prodenia*.—Attack by the common leaf-eating caterpillar *Prodenia litura* F. occurred in Trengganu. (Vid. par. 413, 445).

(v) *Diseases.*

377. During the year, a survey of cacao growing in different parts of the Federation was carried out to discover the distribution and comparative severity of different diseases.

378. (a) *Die-Back*.—One of the most widespread and potentially serious diseases was die-back, associated with the fungus *Calonectria rigidiuscula*. This fungus (in association with capsid attack) commonly causes severe die-back of cacao in West Africa. Its pathogenicity in Malaya has not yet been tested, but an investigation into the problem has been started. *Calonectria* had not previously been found locally on cacao but was known to cause a stem-rot of durian.

379. A different type of die-back, associated with necrosis of the leaf margins and premature leaf-fall, was found in many areas. Particularly severe cases occurred in Trengganu. The symptoms suggest that the die-back is physiological in origin, possibly associated with lack of some of the major nutrients.

380. (b) *Other Diseases*.—Other commonly occurring diseases included leaf-spot (*Gloeosporium* sp.), red rust (*Cephaleuros mycoidea*) and white threadblight (causal fungus unidentified). Less common were brown root disease (*Fomes noxius*) and pink disease (*Corticium salmonicolor*) and leaf-necrosis of seedlings, probably caused by potash deficiency.

6. TEA

(i) *Selection.*

381. It has been decided that the highland-tea clonal trial which was to have been laid down at the conclusion of the present rooting trials should be abandoned for the present. In its place, it is proposed that a clonal museum should be established from those mother-bushes whose cuttings have shown a satisfactory rooting capacity. Certain mother bushes have already been discarded, some have been proved satisfactory and the remainder are being retested, using a new technique and rooting medium.

382. Clonal selection of lowland tea is, however, still proceeding under the direction of the Agronomy Branch of the Department and information on its progress is given in the appropriate section of this report.

(ii) *Insect Pests.*

383. (a) *Enarmonia*.—Severe damage to the buds of lowland tea caused by the leaf-rolling caterpillars of the moth *Enarmonia leucostoma* (Meyr.) was reported. Spraying with DDT was not effective in controlling this pest.

(iii) *Diseases.*

384. (a) *Blister Blight*.—Three fungicidal spray experiments for control of *Exobasidium vexans* were completed at Cameron

Highlands. None of the fungicides tested (two copper and two organic fungicides) was more effective than the copper oxide formulation used as a standard.

385. (b) *Red Root*.—Red root disease (*Ganoderma pseudoferreum*) continued to cause serious damage to lowland tea. *Crotalaria anagyroides* interplanted with young tea was attacked by the less common *Poria hypobrunnea*, but no case of tea being attacked by this fungus was found.

7. RAMIE

386. The time-of-cutting trial has been concluded and a report is being prepared.

387. Four samples of locally produced ramie rope were tested for strength and two of them were examined chemically for completeness in processing. The better ones proved satisfactory in both respects.

8. SOYA BEAN

388. The final variety trials of selections of soya beans, originally obtained from Indonesia, continued at Serdang and were also established in Trengganu. There have been wide differences in viability between seeds of different strains and some strains have been maintained only with difficulty.

9. GROUNDNUT

389. The number of selections were reduced to 20 and these were planted in a final selection trial at the Federal Experiment Station, Serdang.

10. SWEET POTATO

(i) *Selection*.

390. The results of experiments carried out at Serdang on the varieties of the sweet potato collection have indicated that the majority will not tolerate frequent cutting of the tops; as expected, this results in diminishing yields of tubers. There are a few varieties, however, which will give large yields of tops and tubers together; others give large top yields and few tubers or else moderate yields of both. The actual yields of the best are given in Table XXVI.

TABLE XXVI
YIELD OF SELECTED SWEET POTATOES

Variety	Yield (lb. per acre)	
	Tops	Tubers
Samar Big Yeollw (Bed 21)	72,745	10,019
Samar Big Holttum	56,628	4,574
Eng Chai Cheng	52,490	10,672
Taiwan Fan See	45,085	18,077
Serangoon 3	44,540	3,485
Eu Tin	43,778	8,712
Kang Kong 58	43,451	26,571
Hoey Tong	36,590	15,246

These figures were obtained from an unmanured crop cut six times at intervals of two months. All varieties are still being maintained and Kumera, a New Zealand variety, has been added. Further investigations are proceeding.

(ii) *Insect Pests.*

391. Severe attack of tubers of sweet potatoes by the weevil *Cylas formicarius* L. was observed in a crop grown in peat soil in Selangor. Soil treatment with a 0.1 per cent solution of aldrin was recommended. (Vid. par. 445)

11. MAIZE

392. The maize rust *Puccinia polysora*, which has during the past few years caused widespread damage in Africa, is known to occur in Malaya, as specimens from this country have recently been identified by the Commonwealth Mycological Institute. The earliest-found specimen was collected in Selangor in 1950 and it seems likely that the rust arrived in Malaya not long before that date, as the only previous record of a maize rust was of the very but unimportant *Puccinia sorghi*. *P. polysora* is now widespread in Malaya and has also been found in Singapore, North Borneo and the Cocos Islands.

393. As the fungus has been in Malaya for at least six years and during that time no reports of losses caused by it were received either from field officers of the Department or from the public, it would appear that it is causing comparatively little damage.

394. Three varieties of maize received from East Africa, which are resistant to rust there, have been planted to discover whether they are resistant to the disease in Malaya. The indications so far have been that the varieties are resistant here. (Vid. par. 445)

12. TOMATO

395. Field experiments on the control of the widespread and fatal bacterial-wilt disease (*Pseudomonas solanacearum*) were continued. Treatment with streptomycin sulphate, either by dipping the roots or spraying the aerial parts, did not control the disease. Following a local report that the interplanting of maize and tomatoes gives control of the disease, experiments to investigate the effectiveness of this method have been carried out. Results so far have been inconclusive.

13. CABBAGE

396. As a result of reports that DDT, BHC and dieldrin were proving ineffective in the control of the Diamond Back moth (*Plutella maculipennis* Curt.) on cabbage, an experiment has been designed to test these three insecticides and to compare them with two newer insecticides, malathion and diazinon. The experiment will be carried out at the Federal Experiment Station, Cameron Highlands, early in 1957.

14. MISCELLANEOUS VEGETABLES

397. An experiment has been laid down on the control of cutworms which attack carrots, French beans, etc., at Cameron Highlands. The method of control being tested is soil treatment with an insecticide before planting.

398. Laboratory and field investigations are in progress to find the most effective method of controlling the flea beetle (*Phyllotreta sinuata* Steph.) on cruciferous vegetable crops. This pest has been causing extensive damage in Chinese vegetable-holdings near Kuala Lumpur. (Vid. par. 445).

15. PEPPER

399. A wilt disease of pepper, common in Johore, was examined. It appears that the disease is the same as the very serious one known as "sudden death" in Sarawak, the cause of which is at present under investigation there.

16. DERRIS

400. Fifty samples of derris roots from the Federal Experiment Station, Serdang, were analysed in connection with selection work. It was found that the results of ether extract and rotenone content in some cases were very different from those obtained a few years ago for the same selections. The reason for the marked variation is under investigation.

401. The roots from eight samples of derris grown on peat at the Federal Experiment Station, Jalan Kebun, Selangor, were analysed for their rotenone content, which was poor.

17. BANANA

402. The banana collection at the Federal Experiment Station, Serdang, has been maintained. Pruning according to the Jamaican method has been carried out and intercultivation practised, with the result that the crop has greatly improved. Fruit characters of 115 bunches have been recorded during the year.

18. CITRUS

(i) *Fruit Quality*

403. Thirty-three samples of mandarin oranges grown in Perak were received and thirteen were chemically analysed. As compared with foreign (Russian) mandarin oranges, local oranges had less total sugar and acid and the pH was higher. The quality of the mandarin from Perak was poor, but it is possible that it could be improved by suitable manuring.

404. Samples of grapefruit were received from Kedah during November and chemical analysis and canning trials were carried out. Analysis was done for Brix, acidity and pH, and some of each lot was canned as sections in syrup and the rest as juice (see Table XXVII). All varieties contained plenty of juice but acidity appeared low for grapefruit. The seeded varieties are not considered good for canning or eating purposes. The best for processing or eating is GF5.

TABLE XXVII
ANALYSIS OF GRAPEFRUIT FROM KEDAH

Variety	Average Fruit Weight (oz.)	Colour of Flesh	Soluble Solids °Brix	Acidity as % Anhy- drous Citric Acid	pH	S.S. A.	Comments
GF1 Marsh Seedless	12.5	White	8.2	0.81	3.5	10.1	Few seeds present, flavour poor Sections broke up excessively on processing.
GF5 Perlis ..	17.6	"	10.5	0.96	3.4	10.9	Few seeds flavour very good Sections retained shape rea- sonably well on processing.
GF6 McGarty	17.4	"	8.3	0.80	3.6	10.3	Flavour good. Too many seeds Sections broke up on pro- cessing.
GF7 Duncan	—	"	8.2	0.89	3.3	9.2	Flavour good. Too many seeds. Sections broke up excessively on processing.

405. Table XXVIII gives the result of chemical tests of one sample of orange and samples of limes received from the Agricultural Experiment Station, Ayer Hitam, Johore. These analyses fall within the range of those of similar fruits produced elsewhere.

TABLE XXVIII
COMPARATIVE ANALYSES OF ORANGE AND LIME

Variety	Average Fruit Weight	% Soluble Solids °Brix	Acidity as % Anhydrous Citric Acid	pH
Limau Manis ..	170 gm	10.8	0.36	4.35
" Kasturi ..	30 "	10.2	4.36	2.69
" Nipis ..	55 "	8.8	8.0	2.38

(ii) Diseases

406. A root and collar rot of orange trees in Selangor was found to be associated with a species of *Phytophthora*.

407. *Citrus canker* (*Xanthomonas citri*) was of common occurrence, often causing considerable damage. (Vid. par. 411)

19. RAMBUTAN

(i) Preservation

408. Chemical tests and canning trials were carried out. It was shown that this fruit is high in sugar and low in acidity and that it is necessary to add citric acid to the syrup used in canning it. The canned product is palatable and retains its flavour and texture well.

409. Samples of skinned rambutans were stored in the deep freeze, with and without addition of sugar syrup. After five months, it was found that the fruit packed with syrup had kept better; whole rambutans had a better appearance, but the penetration of syrup was better when the seed was removed.

410. The fruit from clones R4, R81 and R86 retained the rambutan flavour and had fairly good appearance when deep-frozen, but this was not true for fruit from clones R11 and R99. (Vid. par. 313, 421)

(ii) Insect Pests

411 Rambutans in Johore were attacked by the leaf-eating larvae of *Chalcoscelis albiguttata* (Snell.), the common gelatine grubs of coconut. Other fruit trees reported to have been attacked included mango, orange and pomelo.

412. Also in Johore, the larvae of *Dichocrocis punctiferalis* G. and *Cacoecia* sp. have been found boring the fruits and the slug-caterpillar *Parasa media* Walk. was found on the leaves. The latter pest also occurred on jambu ayer (*Eugenia aquea*) and jack-fruit in the same area.

413. Rather heavy damage was caused to fruits in Selangor by *Acrocercops cramerella* Snell. This pest, known in Java as the cacao moth, has not yet been recorded from cacao in Malaya.

20. GUAVA

414. Experiments were carried out on the processing of this fruit as guava jelly and as halves in syrup. It is rich in pectin and makes an excellent jelly; full details for its preparation can now be made available. Guava halves in syrup are not an attractive pack due to excessive skin-blemish on the local fruit. There appears to be an abundance of this fruit available which, if processed into jelly, should have good commercial possibilities. (Vid. par. 420)

21. JACK-FRUIT

415. Young jack-fruit trees were badly damaged by the stem-borer *Apriona germari* Hope at the Federal Experiment Station, Jalan Kebun. (Vid. par. 412, 421)

22. MANGO

416. A long-horned beetle borer (*Rhytidodera simulans* White) damaged branches of mango trees in Perak.

23. MANGOSTEEN

417. The edible portions of mangosteens were put into plastic bags and stored for three months in the deep freezer. When thawed out, the samples were found to be soft, with very little flavour and poor appearance.

418. This fruit presents little difficulty in canning except for the excessive labour involved in separating seed from the flesh. As a commercial proposition, it might be best canned as a puree. (Vid. par. 445)

24. PAPAYA

419. During the year, a total of 718 lb. of the Mexican variety was received from the Federal Experiment Station, Serdang, and a total of 263 cans (16 oz.) were packed. Also received from Serdang were 63 lb. of the solo variety; 23 cans (16 oz.) were packed with this fruit. The canning of these two varieties presents no difficulty. Sample cases were sent abroad for market research during November, 1956. (Vid. par. 420, 445)

25. OTHER FRUITS

420. Samples of canned papaya, durian belanda (soursop) and guava were tested by a commercial firm as flavouring for ice-cream preparations. It was reported that papaya is the most promising of these. A larger batch of canned papaya is now undergoing further trials.

421. The following canned products were examined for a cannery which is producing them in Penang and advice was given as to how these products could be improved.

Canned Fruit: rambutan, jack-fruit and mixed fruit juice.

Canned fish: molluscs in curry.

Jams: durian, nutmeg and coconut.

26. FISH

422. *Fish Processing*.—At the request of the Secretary of the Johore Committee on Fish Marketing, a number of experiments were carried out on the canning of local varieties of fish. It was shown that the Kembong (*Scomber* sp.) and Selayan (*Caranx* sp.) gave satisfactory results when packed with brine, curry or tomato sauce. The offal was processed into a fish meal containing up to 62 per cent protein.

423. The Fisheries Department requested information on the possibility of canning cockles in soya sauce. Samples were prepared as follows. After removal of the shells, the fish meat was steamed to cause shrinkage which resulted in the separation of moisture, or "gravy". A mixture of two parts of concentrated soya sauce and three parts of this gravy was used as the covering liquid for the fish in the cans. The samples were reported on by the Fisheries Department, who stated that "your sample No. 50 was most attractive, and was the one which it is recommended should be promoted by industry".

27. PASTURE, FODDER AND FEEDS

424. Twenty-five samples of pasture grasses from Australia were analysed in connection with selection work on non-Malayan grasses. The average results for the 25 samples and results for each of the five containing the highest percentage protein are given in Table XXIX. Only the best of these grasses has more protein than Napier grass, and even the best has much less protein than "local" Guinea grass can produce.

TABLE XXIX
ANALYSIS OF AUSTRALIAN GRASSES

Grass	Moisture (% fresh wt.)	Percentage of Dry Matter					
		Protein	Fat	Carbo- hydrate	Crude Fibre	Ash	CaO P ₂ O ₅
<i>Panicum maximum</i> 16721	75.78	10.06	2.11	37.96	36.91	12.96	.75 .66
<i>P. sp.</i> 17289	77.88	9.89	2.45	40.90	34.19	12.57	.73 .66
<i>P. maximum</i> 16791 ..	76.32	8.90	1.83	39.76	34.81	14.70	.76 .95
<i>P. maximum</i> 16792 ..	77.12	8.86	2.43	41.51	36.40	10.80	.67 .79
<i>P. maximum</i> 16794 ..	78.64	8.68	2.22	39.20	36.56	13.34	.66 1.04
Average for the 25 analysed	74.23	6.48	1.82	42.03	38.22	11.44	.75 .96

425. A dozen samples of green fodder were tested for the presence of hydrogen cyanide and analysed to determine their nutritive value. All of the samples were free from cyanide and the best of them, *Indigofera retroflexa*, contained 18.60 per cent protein on the dry basis. *Mikania scandens* contained 17.8 per cent protein; *Brachiaria brizantha*, *Clitoria* sp. and *Desmanthus virgatus* showed no outstanding features.

426. Three sets of samples of Russian comfrey (*Symphytum peregrinum*) from Cameron Highlands, harvested at monthly intervals, were analysed for moisture and protein content. The samples had high moisture and protein contents. On the dry basis, the protein content ranged from 25 to 32 per cent; Guinea grass, rich in protein, contains a maximum of only 20 per cent.

427. A new formula for poultry mashes has been worked out which is much more economical but has the same nutritive value as the old.

428. Samples of tapioca root, sweet potato, rice polishings, coconut cake and white fish meal were analysed in connection with pig-feeding trials. Chemical analyses for feed value were also done on three samples of poultry mash and four samples of local fish meal.

28. MISCELLANEOUS PESTS AND DISEASES

(i) Plant Pests.

429. (a) *Tobacco*.—The stem-borer *Gnorimoschema (Pthorimaea) heliopa* attacked tobacco in Perak.

430. (b) *Hibiscus*.—Severe crinkling, puckering and invagination of the leaves of rose of Sharon (*Hibiscus mutabilis*) caused by the mite *Aceria hibisci* (Nalepa) occurred in several parts of Kuala Lumpur. Twenty per cent chlorparacide applied at a concentration of 0.1 per cent gave good control.

431. (c) *Indigofera*.—Extensive injury to large areas of *Indigofera teysmanni* was caused by the larvæ of *Tiracola plagiata* Walk. in an outbreak at the Federal Experiment Station, Serdang. The pest was also feeding on a variety of herbs in the vicinity. Control was obtained by fogging with DDT and spraying with DDT and lead arsenate.

432. *Indigofera endecaphylla* was attacked by the larvæ of *Dichomeris ianthes* Meyr. in the same locality.

433. (d) *Cassia*.—Caterpillars of *Catopsilia pyranthe* L. caused heavy damage to the leaves of bushes of *Cassia auriculata* in Kuala Lumpur. Good control was obtained by spraying with BHC.

434. (e) *Peltophorum*.—Severe defoliation of *Peltophorum ferrugineum* trees, also in Kuala Lumpur, was caused by the bagworm *Cremastopsyche pendula* Joannis. (Vid. par. 259.)

435. (f) *Eucalyptus*.—*Eucalyptus* trees were attacked by a leaf-rolling caterpillar, a species of *Laspeyresia*.

(ii) *Soil-Borne Pests*.

436. Tests of the toxicity to termites of soil treated with a range of concentrations of dieldrin and kept indoors in boxes have continued. After two and a half years there has been a fall in toxicity of all concentrations, but in tests the mortality of termites subjected to treated soil is still very much greater than in those subjected to untreated soil.

437. Tests of resistance to termite attack of polyvinylchloride and polythene-insulated telephone cables and of polythene sheets have been continued, the test insect being *Macrotermes gilvus* Hag. Cables and sheets were only very slightly attacked, even when buried in close proximity to a termite nest.

438. An experiment has been designed to test the residual effects of several insecticides in different types of soil. Preliminary laboratory tests are at present in progress to find a suitable test-insect for this experiment and to work out reliable testing technique.

(iii) *Stored Products*.

439. Insects infesting chocolates included *Ahasverus advena* Walk., the foreign grain beetle, and *Ephestia cautella* Walk., the fig moth.

440. Advice was given on the preservation of books in storage.

441. Pests of stored rice in godowns were investigated on several occasions and advice on their control was given. Insects commonly encountered included the flour moth (*Corcyra cephalonica* Stn.), the saw-toothed beetle (*Oryzaephilus surinamensis* L.) and the fig moth (*Ephestia cautella* Walk.).

(iv) *Quarantine*.

442. Numerous consignments of planting material for export and import were examined by the Entomologists and Plant Pathologist. Imported consignments of pineapple planting material were kept in quarantine at the Isolation Station, Pulau Tekong, and in the insect-proof house in Kuala Lumpur.

443. During the year, 300 specimens were added to the mycological herbarium. Duplicates of 219 herbarium specimens and 43 cultures were sent to the Commonwealth Mycological Institute and 57 herbarium specimens were sent to the Royal Botanic Gardens, Kew. Identifications for 245 were received.

444. During the year, 215 insect specimens were sent to the British Museum for identification.

(v) New Records

445. Among the many new records of plant diseases, insect pests and mites made during the year, the following are of interest:

Host	Damage	Organism
Mangosteen	Brown rot	<i>Fomes noxius</i>
<i>Duranta plumieri</i> ..	Wilt	<i>Sclerotium rolfsii</i>
Maize	Banded sheath rot ..	<i>Corticium solani</i>
<i>Asystasia coromandeliana</i>	Leaf rot	" "
<i>Dolichos lablab</i>	"	" "
Sweet potato	Tuber black rot ..	<i>Ceratocystis paradoxa</i>
<i>Eugenia aquea</i>	Sudden death ..	<i>Valsa eugeniae</i>
Water melon	Wilt	<i>Fusarium</i> sp.
Loofah	Leaf spot	<i>Cercospora citrullina</i>
Coconut	Leaf spot	<i>Helminthosporium incurvatum</i>
"	Larvæ on dry leaf ..	<i>Decadarchis carpophthar</i>
Papaya	Mites on stem bark	<i>Proctolaelaps (Jordensia)</i> sp.
Rice	Leaves	<i>Rhopalosiphum rufiabdominalis</i>
"	Mites on leaves ..	<i>Oligonychus</i> sp. ? <i>pratensis</i>
Cacao	Leaves	<i>Acanthopsyche</i> sp.
"	Stem (under bark) ..	<i>Opogona theobroma</i>
"	Young leaves	<i>Pemone frenata</i>
"	Leaves	<i>Limacosilla pirifera</i>

29. CROP SAMPLING AND ANALYSIS

446. A sample of palm oil from South Perak was examined and its moisture-content was found to be excessive.

447. Tests for the presence of prussic acid were made on two samples of *Phaseolus lunatus* and one sample of tapioca.

448. The moisture content of 32 samples of padi and rice was determined in connection with field trials of varieties.

449. One sample of coconut and one of copra cake were analysed.

450. Ten samples of copra were analysed for oil content in connection with varietal selection work.

451. A sample of locally grown coffee of the variety Arabica was tested and the flavour was found to be acceptable.

452. Two varieties (black and brown) of locally-grown sesame seed were examined chemically. The black variety had a higher oil content, but the colour of the oil was the same in both.

453. Chemical analyses were made on the following samples for other Divisions of the Department: two samples of fish-pond water; two samples of pericarp from mantled oil palm; one sample of fruit of *Elaeis melanococca*; seven samples of red beet from Cameron Highlands; palm oil for testing for arsenic; qualitative analysis for lead in plastic cable; and identification of solvents used in Dieldrex and in DDT formulations.

454. Altogether, 150 samples, in the following categories, were received from the public for analysis: palm oil (91); coconut

oil (35); oil palm pericarp residue (15); palm kernels (3); palm bunches (3); coconut expeller chips (1); boiler feed water (2).

455. Information was given on the following subjects: oil palm presses; machinery for a small oil palm factory; apparatus and methods for leaf analysis; processing cashew nuts; rice hulling and parboiling; and extraction of rotenone from derris.

30. SOIL INVESTIGATIONS

456. The work of the Soil Science Division is concerned with soil analyses and similar studies related to soil amelioration and the problems of crop nutrition, as well as with soil surveys. Much of the work in progress has been referred to previously in this report where it is directly related to problems with individual crops; the more general aspects are referred to hereunder.

457. Two senior officers were engaged on soil survey from the beginning of the dry season in February until the middle of the year, when they both went on leave. No new large-scale surveys were commenced during the year. Consequently, there was a considerable decrease in the number of samples received for routine determinations and analytical work in arrears was brought up to date and more time was devoted to research work into the more fundamental aspects of Malayan soils. In particular, the correlation between the properties of the different soil series, as determined by laboratory examination and as noted in the field, received more attention. Research into methods of sampling, storage and analysis has improved the accuracy of determinations and enabled a larger number of samples to be handled.

(i) *Soil Sampling and Analysis.*

458. During the year, 4,300 soil samples were received and a total of 46,000 soil analyses were carried out. During the same period 500 plant samples were obtained in connection with nutrition work and 4,800 analyses were done on these. Also, 544 water samples and 25 samples of fertilisers and manures were examined.

459. (a) *Sampling Methods.*—Some preliminary work has been done to find the best method of sampling padi soils and to find the minimum number of samples required to make a composite sample which will give a sufficiently accurate determination of the mean of a given variable.

460. A half-acre block at Tanjong Karang, Selangor, was sampled and determinations of pH and conductivity were carried out. There are indications that a composite of 10 sub-samples gives a good estimate of a mean and this procedure has been followed in some padi areas in Pahang.

461. (b) *Analyses—(1) Control.*—Owing to the fact that very large numbers of samples have to be analysed in connection with soil surveys, it is impossible to do duplicate analyses on every sample. A system using standard samples of known composition has, therefore, been adopted. Five standard samples are in use and these are made from soils with widely different characteristics.

In mechanical analyses, one estimation in every thirty is on a standard sample, while for nitrogen, phosphorus, potassium and carbon, one estimation in every twenty is on a standard sample. Examination of the results of analysis of a standard sample thus shows whether the analysis of that particular batch is in order.

462. Due to the waterlogged condition in which a padi soil exists for the greater part of the growing season, reducing conditions are present except in the top 0.5 to 1 cm. Thus, analyses of an air-dried soil may give misleading results and composite samples taken from some padi areas in Pahang are being used to study this problem. After receipt of the samples, they are thoroughly mixed with water to form a smooth paste. Each sample is then divided into two; one half is air-dried and the other half is stored in waxed containers with water covering the soil. Analyses are being carried out on both sub-samples.

463. (b)—(2) *Mechanical Analysis*.—The standard method of mechanical analysis at present in use in the laboratory is the Bouyoucos method using sodium silicate and ammonium oxalate for dispersion. The use of complex poly-phosphates sold under proprietary names is now being investigated. It has been found that 3 gm. of one of these materials with 50 gm. of soil gives a better dispersion than the standard method. Care must be taken to subtract a blank reading, but the method has considerable promise for routine use.

464. (b)—(3) *pH*.—The use of plastic beakers mounted on a plastic base in groups of five has speeded up determinations. Investigations have been carried out on the effect of storage on *pH* of soil samples and it was found that in samples from Kedah which had been stored for a year the acidity had increased by as much as one *pH* unit. The change in *pH* of a sample from the time when it first arrives at the laboratory until it has been air-dried and ground has also been investigated. With the exception of samples containing sulphur, there is little change in *pH*.

465. (b)—(4) *Cation Exchange Capacity (C.E.C.)*.—Work has continued on the use of barium chloride with triethanolamine as a leaching agent and the method has now been developed to a semi-routine status. Possible improvements, including the use of ion-exchange columns for concentration of the cations, are being examined.

466. Further determinations have been carried out on the soils from the Kedah padi-soil survey. It has been found that the Kedah soils generally have C.E.C. values in the range of 20 to 40 m.e. (mille equivalents) per 100 gm. of soil. The percentage saturation is highest (often over 90) in the newly formed coastal clays and proceeding inland it falls to as low as 10. The cacao soils in Trengganu have C.E.C. values of 20 to 30 m.e. per 100 gm. of soil and the percentage base saturation is seldom above 20.

467. The use of cation exchange resins in soil analyses is under investigation, but so far only the exchange capacity of the resins has been determined. Their use as a method of concentrating solutions for flame-photometer analyses is also being

investigated. It has been found impossible to determine potassium in very dilute solutions and the use of resins might offer a simple method of concentration, preferable to evaporation.

468. (b)—(5) *Sulphates*.—The gravimetric method of determining sulphates is time-consuming, particularly as large numbers of analyses are needed in connection with *gelam* soil investigations, and it is also subject to errors. Investigations are proceeding into volumetric methods of determining sulphates.

469. (b)—(6) *Phosphorus*.—During the year, a considerable amount of time was devoted to work on soil phosphorus. Fifty samples from representative profiles have been selected and determinations of total, readily soluble, organic and fixed phosphorus are being carried out. Preliminary work was done on the interference of silica in the determination of P in total P estimations and it was found that tartaric acid was effective in suppressing this interference.

470. (b)—(7) *Nitrogen*.—Following requests for determination of nitrates and ammonia in water samples from padi fields in Negri Sembilan, several methods of determining these two constituents were tried. A method using Nessler's reagent was found to be suitable for ammonia determination. For nitrates, the phenol-disulphonic-acid method was satisfactory. For the nitrate determination, careful standardisation of pH is necessary.

471. (c) *Irreversible Drying*.—An interesting problem arose on an oil palm estate where palms 5 to 6 years old were growing very badly. Investigation showed that the soil, which was a peaty clay, had suffered irreversible drying and had two-inch-wide cracks down to 18 in. When the soil was examined immediately after heavy rain, it was as dry as dust and even at a depth of 18 in. it felt distinctly warm. Various methods of restoring the soil, including blocking the drains and raising the water table, have been suggested.

(ii) *Soil Surveys*

472. With completion of the location of some 100,000 acres of soil suitable for cacao development, dry-land surveys are now being devoted to delineating and assessing virgin land in the less developed states on the East Coast for development under other crops. With the inauguration of the Land Development Authority, requests were received for soil surveys of areas of the order of 2,000 to 4,000 acres scheduled for land development schemes. Three such areas have been surveyed and large-scale soil maps (5 in. to 1 mile) have been produced.

473. Survey of padi land has been mainly concerned with the developed areas of Kedah, for the purpose of intensifying production by the more efficient use of fertilisers and other agronomic methods. This is to be followed by a similar survey in Kelantan. Surveys of a number of potential padi areas have also been carried out.

474. With increased staff and improved facilities offered under the Draft Development Plan, it is expected that the rate

of soil surveying will be increased by at least 50 per cent in the next year or two. A scheme for training Agricultural Assistants attached to State staff establishments has been implemented and has already greatly assisted in widening the scope of the soil-survey programme.

475. (a) *Dryland Surveys.*—(1) *Trengganu.*—(i) *Cacao Soils.*—The soil-survey field programme in Trengganu was a continuation of the previous year's activities, which were interrupted by the north-east monsoon. Field excursions of reconnaissance and detailed-reconnaissance nature were made in the region of the Bukit Bauh Forest Reserve between the Sungei Dungun and the Sungei Paka, and in the area around Sungei Tebak and Bukit Bundi farther to the south.

476. Large-scale soil-survey activities in Trengganu have now been suspended, and results of the work carried out during the past three years are being summarised and will be published. Maps of the four main potential cacao-growing areas have been completed and short reports have been issued to accompany each map. The total acreage of soils suitable for cacao in these areas amounts to about 90,000 acres, and this land, which comprises the best soil at present remaining undeveloped in Trengganu, should be sufficient to meet the demands of the expanding cacao industry in this region for some years to come.

477. (a)—(1)—(ii) *Gunong Padang.*—A short reconnaissance of the mountain soils in central Trengganu was also made; a feature of this trip was the examination of the soils which support the unusual wooded high-savanna type of vegetation near the top of Gunong Padang. The soils in this latter area, which are derived from white granite, proved to be rather poor, pale-coloured and sandy. They display marked podzolic characters, including a pronounced surface humus horizon and strongly leached subsoil with a faintly developed zone of accumulation about 2ft. below the surface. As far as is known these soils are peculiar to that one part of Malaya, and the strangeness of the vegetation which constitutes an edaphic climax can be attributed primarily to the influence of the soils.

478. (a)—(1)—(iii) *Kampung Tok Dor.*—This is a Land Development Authority scheme of approximately 1,800 acres. The land was found to be suitable for rubber and *dusun* (fruit culture).

479. (a)—(2) *Kelantan.*—(i) *Deficiency Area.*—The laboratory work and pot experiments in connection with this survey, which was described in the 1955 report, were completed. In all, approximately 60,000 acres were surveyed and eight soil series and two soil associations were mapped. Five of the series, occupying 38,000 acres, have been classified as "deficiency soils" and these, together with the peat and muck associations, render over 70 per cent of the area relatively unsuitable for development.

480. A series of five bulked samples from the area were used in "subtractive-type" pot experiments with tomatoes as an indicator crop. Treatments included presence and absence of the major nutrients and trace elements. A farmyard-manure treatment was

also included. Deficiency symptoms of phosphorus, magnesium and calcium were demonstrated and some of the plants showed a deficiency of what was thought to be molybdenum. The farmyard-manure treatment gave very good initial growth but certain symptoms, thought to be deficiencies of minor elements, appeared in the later stages. The Kampong Pusu series of soil gave the best growth.

481. Analyses were carried out on the soils from the pots after the experiment was completed. It was noted that the greatest increase of "readily soluble" phosphorus was in the soil with the least clay and that there was a fairly close correlation between phosphorus fixation and clay content.

482. Typical profiles of the different soil series were also analysed; the outstanding fact which emerged, apart from the low phosphorus values, was that the percentage base saturation was extremely low—generally between three and ten.

483. (a)—(2)—(ii) *Batang Merbau*.—Preliminary to a more extensive survey of soils in the Kelantan hinterland to be undertaken in 1957, a short, detailed reconnaissance survey was carried out in this district; it revealed an area of deep, well-structured soils, developed from quartzites and other sedimentary rocks. There is a possibility that some of these soils may be suitable for cacao.

484. (a)—(2)—(iii) *Ayer Lanas*.—Another trip was made in the Ayer Lanas area and about 2,000 acres of land, mostly suitable for rubber and *dusun*, were mapped for a Land Development Authority scheme.

485. (a)—(3) *Pahang*.—(i) *Kampong Awah*.—The Agricultural Assistant, Pahang, carried out a survey in the Kampong Awah area. An area of 4,000 acres was surveyed on a scale of $2\frac{1}{2}$ in. to 1 mile and two major soil series were identified. These were the Kampong Awah clay and the Kampong Bakah clay. The Kampong Bakah clay differs from the Kampong Awah clay chiefly in colour but it often has a lateritic phase also. Cacao seems to do well on the Kampong Awah clay and, though the Kampong Bakah clay would appear suitable, it has been suggested that trial plantings be made before areas with this soil are developed.

486. (a)—(3)—(ii) *Bukit Goh*.—The field work in this area was completed by the Agricultural Assistant, Pahang, and two visits were made by the Soil Surveyor to correlate the work. A map of the area on a scale of 1 in. to 1 mile has been prepared and this shows about 9,000 acres of basalt soils suitable for cacao. This area of good soils is smaller than was thought at first, due to the large number of small swamps.

487. (a)—(4) *Negri Sembilan*.—(i) *Durian Tipus*.—A land Development Authority scheme of approximately 1,900 acres in the Simpang Pertang and Durian Tipus area was examined. The soil, derived from quartzites and shales, had strong laterite development in some areas, but generally it was judged suitable for rubber and *dusun*.

488. (a)—(4)—(ii) *Petasseh*.—An area at Petasseh, where there is a small cacao plot, was examined in more detail and it was found that the soil, though very closely resembling the basalt soils of Kuantan, is in fact derived from serpentine. Growth of cacao on this soil is poor and it was thought that excess magnesium might be the trouble. However, soil analyses did not reveal high concentrations of Mg and the possibility of nickle toxicity is being considered.

489. (b) *Padi Land Surveys*.—(i) *Kedah-Perlis*.—During the 1956 field-season, the reconnaissance soil survey was completed. In all, 759 pits have now been examined and the horizons of each have been described, sampled and analysed. In addition, auger borings to a depth of 5 ft. were made and samples were taken at 75 sites where flooding prevented examination of pits. Most of the auger borings were located in the area of North Kedah and Perlis still largely occupied by *gelam* forest.

490. The field work in 1956 was concentrated almost entirely in Perlis and the area of the Kedah Plain lying north of Alor Star. The soils generally were found to fall within the tentative classification given in the Annual Report for 1955, but the following modification of that classification was found desirable.

- (a) Family A—Marine Deposits—5 Series.
- (b) Family B—Soils Transitional Between Family A and Family C—2 Series.
- (c) Family C—Flood Deposits (Under Estuarine Conditions).
 - (i) Sub-family I—Simple estuarine deposits—4 Series.
 - (ii) Sub-family II—Estuarine deposits with overlying colluvial layer—6 Series.
- (d) Family D—Flood Deposits (Under Fresh Water or Slightly Brackish Conditions).
 - (i) Sub-family I—Levee deposits—2 Series.
 - (ii) Sub-family II—Sheet deposits—2 Series.
- (e) Family E—Trough and Basin Deposits.
 - (i) Sub-family I—Trough deposits—2 Series Complexes.
 - (ii) Sub-family II—Basin deposits—2 Series.
- (f) Family F Colluvial and Colluvial-Alluvial Deposits.
 - (i) Sub-family I—Colluvial deposits—5 Series.
 - (ii) Sub-family II—Colluvial-alluvial deposits—6 Series.

491. Thus, some 40 identifiably different soils were found during the course of the reconnaissance survey, but it is unlikely that time will permit detailed mapping of each one of these. Mapping will be carried out of individual series where these cover a large area and of sub-families consisting of very closely related series, where the area occupied by each series is not large. The number of mapping units can thus be cut down to 20 or fewer

without seriously impairing the accuracy or usefulness of the final map. Correlation of the results of laboratory analyses of soil samples with series classification of the soils is now in progress.

492. (2) *Perak*.—The further soil survey of 34,000 acres in the South-East Trans-Perak area has been completed. This is one of the most promising potential padi-areas so far examined, as peat is completely absent. The soil is mostly heavy clay, though there are a few ridges of sandy material.

493. (3) *Selangor*.—The report of the Kuala Langat North Forest Reserve was completed. Out of a total of 49,000 acres, 39,000 were found to be deep peat and 7,000 undulating ground; therefore, only 3,000 were suitable for padi.

494. (4) *Malacca*.—A detailed soil survey was carried out at the Federal Experiment Station, Pulau Gadong. One composite sample (three sub-sample sites) per acre was taken for each of the sampling depths, 0 to 6, 6 to 12, 12 to 24 and 24 to 36 in. Sampling was done to compare the sulphate content of the soil from the cultivated and uncultivated areas. The soil which had been cultivated since 1935 had very little sulphate even at a depth of 3 ft. By far the highest sulphate content was found in the undrained fields south of the road. (Vid. par. 468)

B.—AGRONOMIC AND LIVESTOCK INVESTIGATIONS

1.—PADI

(i) *Mechanisation*.

495. The Bisset semi-mounted binder was tested at the Paya Besar Padi Station in Pahang. This machine performed satisfactorily in slightly lodged crops of dry padi, when equipped with Denny grain lifters. It could not handle seriously lodged crops, however, and the combine harvester remains the only machine which will carry this out satisfactorily.

496. Trials of the Rajah semi-mounted thresher were undertaken at the same station, in conjunction with those of the Bisset binder. The cost of reaping and the threshing with these machines was \$22.50 per acre or \$3.92 per picul of grain. These costs are among the lowest recorded in harvesting trials in Malaya, and are slightly lower than the average cost of combine harvesting under good conditions.

497. Mechanical threshing of padi usually results in a higher proportion of damaged grains than that found in hand-threshed samples. The effects of drum speed, concave setting, reaping technique and grain moisture content on the amount of grain damage were investigated in a preliminary way at the Paya Besar Padi Station. The results were not conclusive, however, and further tests are necessary.

498. Traditional sun-drying methods of reducing the moisture content of harvested and threshed grain to levels suitable for storage of the grain are not satisfactory when large outputs have to be handled, as when crops are mechanically harvested and threshed. The possibility of adapting ventilated storage bins for

large scale grain drying was therefore considered and investigated. Waste heat from an engine was employed to reduce the relative humidity of the air. A two-ton installation was tested and it was found that this could deal with the output from a combine harvester with a 10 foot cut.

499. Extensive trials were carried out with a wide range of imported animal-drawn ploughs. None were substantially more efficient than the type traditionally used in Malacca, though the best Japanese implement was about 10 per cent more efficient. The Kedah type of plough did not compare so favourably with imported models as did the Malacca type. Generally, the foreign ploughs could not achieve the thorough inversion of the furrow slice required in Kelantan. The Indian Sabash plough most nearly met this requirement.

500. A winch-drawn mole plough was developed for mole-draining areas in which conventional trailed implements are not satisfactory.

501. Development continued at the Padi Mechanisation Pilot Station near Parit, in the Trans-Perak Irrigation area. Thirty acres of jungle were cleared, and the area of 70 acres cleared in 1956 was sown in August and September. An access road and various buildings were constructed and plans were made for internal irrigation of the station in 1957.

502. There were many unforeseen difficulties in getting water for the crop, and because of this, water was available, at a fraction of the rate required, over only about 25 acres of the area planted. The bulk of this area was therefore sown with dry-padi varieties.

503. The water shortage allowed much more vigorous weed growth than would normally be expected, and rats, birds and pigs from the surrounding areas seriously damaged the growing crop, in spite of intensive efforts to control them.

504. The average cost of jungle clearing and land preparation for cultivation was about \$130 per acre—very much less than had been estimated. The average cost of cultivation and sowing was about \$31 per acre, which is also very encouraging.

505. While, therefore, it seems unlikely that much positive information will be obtained from the first crop, it has been shown that jungle land can be cleared and sown mechanically at a very much smaller cost than had been expected. It is hoped that satisfactory cropping data will be available after the second and third crops, which are to be grown on holdings of varying size and with improved irrigation and pest control resources.

(ii) *Agronomy.*

506. (a) *Wet Padi.*—The great majority of trials harvested at the end of the 1955-56 season and of those laid down in the 1956-57 season were designed to elucidate problems of manuring wet padi. A number of experiments dealing with cultural problems were conducted in both seasons, however.

507. The major objects of the manurial experiments were determinations of the most suitable types and amounts of phosphate, of the optimum proportions in which the main nutrients should be applied, of the value of nursery manuring and of the special manurial needs of padi growing on peat.

508. The cultural trials mainly dealt with problems of straw disposal, spacing, multiple cropping and drainage and with joint problems of manuring and various cultural practices.

509. The more complex trials were sited on established experiment stations, but large numbers of blocks of simple 6- and 3-treatment investigations were undertaken on cultivators' fields, considerably more than in the 1956-1957 season.

510. Some of the more important indications from work in the 1955-1956 season are described below.

511. The results of factorial trials on two stations in Kedah suggested that while nitrogen was the most important requirement for increasing grain yields, there was a substantial difference between the two sites in regard to the optimum amount required. In one case there was a linear yield increase over the range of application of 0, 30 and 60 lb. of N per acre, while in the other the response to the second 30 lb. of N was much less than to the first.

512. The findings from a similar trial on a station in Negri Sembilan were parallel with those of the first of the Kedah experiments. An increase of about 330 lb. of grain was obtained in this trial from an application of just over 60 lb. of N per acre.

513. Results from another factorial trial undertaken at several stations in Kelantan suggested that whereas nitrogen was the main requirement at Kota Bahru and at Pasir Mas, phosphate was more important at Bachok and Pasir Puteh. At the latter sites there was the further suggestion that double superphosphate was more effective than C.I.R.P.* The response to 40 lb. nitrogen was of the order of 300 to 370 lb. grain, that to 20 lb. P_2O_5 as superphosphate was 450 lb. grain (Pasir Puteh) and that to 40 lb. P_2O_5 as C.I.R.P. was 345 lb. grain (Pasir Puteh).

514. The effects of N, P & K and of burning and liming have been investigated for some years now in trials on peat in Trengganu. In one of these only N & K were applied, where appropriate, so as to examine the possibility of residual effects of burning, liming and phosphate application in the previous season. There were appreciable positive residual effects of burning and phosphate application, but none of liming. These effects were not sufficient to raise yields to a satisfactory level, as were the direct effects in the previous season. Very small or no yields were obtained from plots which had not been burnt or dressed with phosphate in the previous season.

515. Nursery manuring with 2 lb. ammophos 11:48 per gallon of seed increased yields by 120 to 230 lb. of grain per acre

* C.I.R.P. = Christmas Island rock phosphate.

in trials on Province Wellesley stations, but had no effect in similar trials on Malacca stations. The former highly profitable responses were exploited in large numbers of tests on cultivators' fields in Province Wellesley.

516. Considerable evidence was obtained from trials on cultivators' fields about responses to phosphate (of two types) and nitrogen. Satisfactory interpretation of this evidence has proved difficult. The major problems are that there is not sufficient ancillary information about the various factors which influence responses to fertilisers at the various block sites, so that it is difficult to classify the results into groups uniform for these factors, and secondly that information about the course of the experiments is also inadequate; the latter difficulty resulted from attempting investigation on a scale modest enough in relation to the needs, but too great for satisfactory supervision and conduct of the experiments by the staff available. It will be possible to obtain useful information from the work, but the process will take time.

517. (b) *Dry Padi*.—Investigations were continued at Melor and Kampong Pusu in Kelantan and at Paya Besar in Pahang. An experiment at the first of these stations suggested that the requirements of this crop for nitrogen and phosphate (in the form of double superphosphate) are in the ratio of about 2:1, and that—in this proportion—about 90 lb. of N gives a response of some 350 lb. of grain and about 40 lb. of P_2O_5 gives a response of some 360 lb. of grain.

2. OIL PALM

518. Experiments were continued at Serdang and on estates in Selangor. Areas of palms were established and maintained at Jerangau and Serdang for the Botany Division of the Research Branch.

519. The results from a trial at Serdang indicated that the addition of limestone to a basal dressing of N, P, K & Mg caused a reduction in yield of fruit bunches.

520. A preliminary appraisal of interim results from a long-term manurial trial on an estate in Selangor suggests that potash may have had a slight beneficial effect on yields from six-year-old palms.

521. Yields from a long-term replanting and manurial trial at Serdang suggest that young palms underplanted one year before felling the old palms tend to equal the performance of those planted after the old palms were felled. Approximate yields in lb. of fresh bunches per acre were as follows:

		June, 1954, to Dec., 1955	1956
Young palms planted 1950-1951	(a) Planted after felling	1,330	3,450
	(b) Planted 1 year before felling	1,460	2,900

522. Young palms at the Federal Experiment Station, Jerangau, continued to grow outstandingly vigorously.

3. COCONUTS

523. Some 20 to 30 acres of land were planted with selections of tall, semi-tall and dwarf coconuts at the new Federal Experiment Station, Telok Bahru. Drainage and lalang eradication were begun on a further 30 acres of land.

524. Significant increases in yields of nuts from old palms were obtained in a simple manurial trial on smallholders' land in coastal Trengganu. Calculated average numbers of nuts per acre are summarised below:

	A (14 lb. NPK per palm per annum)	B (7 lb. NPK per palm per annum)	C (No fertiliser)
Pre-treatment year (6 harvests, September, 1953 to July, 1954) ..	990	866	1,131
First treatment year (7 harvests, August, 1954 to July, 1955) ..	683	551	537
Second treatment year (7 harvests, August, 1955 to July, 1956) ..	1,152	669	605

These increases are not sufficient to pay for the fertiliser used, at current fertiliser and copra prices.

4. PINEAPPLES

525. A number of experiments were concluded during the year, and plans were made for a new programme designed to answer certain of the still outstanding agronomic problems. The intention was that this programme should be carried out entirely at the Federal Experiment Station, Alor Bukit. Unfortunately, acute staff shortages have developed and have caused indefinite postponement of the programme.

526. A review of results of completed trials confirmed previous opinions that potash was the main nutrient required by pineapples on peat but threw little fresh light on questions of the need for phosphate and nitrogen.

527. Large increases in yield were obtained when the initial plant density of Singapore Spanish pineapples was raised from the traditional 3,000-4,000 per acre to 7,000 per acre, and there was evidence that further increases would be obtained if the density was raised to 14,000 per acre.

5. CACAO

528. Very little new investigation was initiated during the year; attention was confined to the maintenance of existing experiments, the establishment of new botanical material and trials, and the further development of the Federal Experiment Station, Jerangau.

529. Co-operative thinning, establishment and manurial experiments on Jerangau Estate were concluded towards the end of the year. These trials, laid down on the estate in the early days of development in 1951, have yielded information which has been

of very great practical value in evolving techniques and practices for the establishment and cultivation of young cacao in Malaya. They have given clear indications of the extent to which jungle should be thinned before planting cacao and of the need for phosphate for satisfactory early growth on Jerangau-type soils. Final reports on these trials are in preparation.

530. A spacing experiment with Trinitario cacao was planted in 1951 on Jerangau Estate and is beginning to give interesting results. Growth in stem girth was considerably greater when trees were spaced at 12×12 ft. than when they were planted at either 10×10 ft. or 8×8 ft. Yields per acre were greater at 8×8 ft. than at either 10×10 ft. or 12×12 ft., but the reverse appeared to be the case in regard to yields per tree. These results can only be regarded as interim indications for the present, as it is unsound to judge spacing treatments finally until yields have been obtained for a number of years after the trees have reached maturity. Nevertheless, the figures prompt speculation about the potentialities of close spacing upto and including the first few bearing years, followed by gradual thinning to wider spacings.

531. The first crop from a spacing experiment with Amelonado cacao, also planted on Jerangau Estate, in 1954, indicates per acre yielding trends similar to those described above.

532. A small fertiliser experiment with Amelonado cacao planted on the Federal Experiment Station, Jerangau, in 1954 gave interesting results. The experimental treatments comprise the 9 factorial combinations of rock phosphate and magnesium limestone, each absent and at single and double levels of application. Both the limestone and the phosphate have enhanced growth in stem girth. The indications are that the double level of phosphate, the double level of limestone and the single levels of both together are the most effective treatments in this respect; there is some evidence that, of the three, the last has the greatest effect. The single levels of phosphate and limestone in 1956 were 10 and 20 oz. per tree, each in two doses applied 6 months apart. The disappointing feature of the experiment is that none of the treatments have given rise to really healthy growth. Indeed, throughout the area of the trial, symptoms of poor leaf and shoot growth have developed during the course of the year. These symptoms were also found elsewhere than in the trial area. They are undoubtedly frequently associated with physical damage by pests, falling branches and the like, but the general opinion is that there is a more fundamental cause, probably nutritional. A programme of investigation was designed to elucidate the problem further.

533. The scale of a large, relatively new establishment experiment at the Federal Experiment Station, Jerangau, was greatly reduced after review of the progress and value of the various methods of establishment.

534. A small seedling potting observation showed that wood veneer tubes were satisfactory as containers for seedlings and were very much cheaper to use than the orthodox planting baskets.

535. Yields of cacao from Amelonado seed gardens at the Federal Experiment Station, Serdang, were much lower than in 1955. The figures were as follows:

AVERAGE NUMBERS OF PODS PER ACRE
(trees planted in March, 1950, under cultivated shade)

Year	Fields 44A & B		Field 46A
1955	2,470	..	4,400
1956	1,490	..	2,970

The reason for this fall is not understood; many possible reasons have been suggested but none really explains the circumstances satisfactorily. Those that appear most plausible are firstly that the Serdang soils are unsuitable for maintenance of high yields from maturing cacao and secondly that comparatively slight climatic differences may cause fairly large variations in annual yields.

6. TEA

536. The main agronomic investigations were undertaken at the Federal Experiment Station, Cameron Highlands. Work at the Federal Experiment Station, Serdang, comprised continuation of a long-term programme of establishment of material from selected clonal mother bushes. A very successful technique for taking, rooting and establishing cuttings was developed in the course of this work.

537. The bushes in an investigation of the effects of several levels of nitrogenous manuring were brought into bearing in March, after pruning at the end of the first cycle. Yields were greatest at the highest level of application.

538. Tea was pruned in early 1956 at the end of the first cycle of an NPK 3² factorial trial. The average yield per acre of green leaf over the three years of the cycle was 9,033 lb.; although statistical examination of the data is not yet complete, it is amply clear that substantial and highly profitable increases in yield were obtained by the application of nitrogen and phosphate. Table XXX illustrates the extent and nature of the increases.

TABLE XXX
CALCULATED MEAN YIELDS OF MADE TEA
(in lb. per acre for the entire 3-year cycle)

Treatment	No nitrogen applied	953 lb. sulphate of ammonia and 91 lb. urea per acre supplied		Means
No phosphate applied	1,818	..	1,946	1,882
243 lb. C.I.R.P. per acre applied	1,864	..	2,321	2,093
Means	1,841	..	2,134	1,987

These figures clearly show that while nitrogen and phosphate each separately increase yields, they are vastly more effective when they are applied together.

7. COFFEE

539. Manurial trials on peat and varietal trials in the hills were continued at the Federal Experiment Stations, Jalan Kebun and Cameron Highlands, respectively. There are two manurial trials on peat, one involving the 32 factorial combinations of presence and absence of burning, liming, nitrogen, phosphate and potash, and the other testing the effects of various minor elements (manganese, boron, copper and zinc). The coffee in both trials came into bearing during the year, but it is still too early to form any very definite opinions about treatment effects on yield.

540. Growth generally has been unsatisfactory in both trials, but it is clear that this has been due to cultural errors as well as to nutritional deficiencies. In regard to the former, the main difficulty has arisen from differential compaction of the peat. Disc-harrowing caused consolidation of the peat between rows and tended to leave the bushes high and dry on individual, "fluffy" mounds, with undue root exposure and bush-leaning resulting.

541. In the trial of burning, liming and major elements, the potash and to a lesser extent the burning treatments caused notable improvements in growth. These were such as to justify the conclusion that young *Liberica* coffee can be grown satisfactorily on deep peat soils in Malaya; whether or not such cultivation is economic can only be judged in the future, when yield data become available.

542. Copper continued to be the only minor element which caused any improvement; it increased vigour and gave a better leaf colour and shape, when applied in Bordeaux mixture form.

8. FIBRES

543. The Manila hemp variety Tangongon continued to out-yield Bangulanon at Degong in Lower Perak. Very low fibre yields were obtained in a trial with Mauritius hemp at the Federal Experiment Station, Serdang.

9. FRUIT

544. Most of the fruit investigational work is carried out at the Federal Experiment Stations, Serdang and Gajah Mati; experiments were also conducted at various State Agricultural Stations in Perak, Selangor and elsewhere. The major part of the work was concerned with the evaluation and comparison of rambutan and durian clones.

545. During the year an important rambutan clonal trial at the Federal Experiment Station, Serdang, was reviewed on the basis of the data of the first few harvests. The indications were that clones 86, 7, 4, 12, 10 and 3 were all high-yielding types and that 3, 4, 7 and 12 were outstanding from the qualitative point of view.

546. Some preliminary work was undertaken at Serdang on the evaluation of open-pollinated seed of certain rambutan clones for use as rootstocks. There was considerable variation between the clones in stock seedling vigour and this appeared to be

reflected in subsequent scion growth. Clones 9, 11, 68, 81 and 84 seemed to be more suitable for use as stocks on this basis than other clones.

547. A range of fruit trees was planted on deep peat in the early days of developing the Federal Experiment Station, Jalan Kebun. Certain of these—notably rambutan, jack fruit, mango and guava—grew vigorously and most promisingly during the year and the jack fruit produced good crops of fruit.

548. At the Federal Experiment Station, Gajah Mati, where grapefruit of outstandingly high quality are produced, a variety trial of seven varieties was laid down. In addition, preparations were made for a series of observations of the values of various rootstocks for budgrafting with clonal citrus of several types.

549. A considerable planning programme was undertaken in efforts to implement the policy of increasing and improving the production of local fruit. The work which was envisaged involved investigation of various methods of multiplying clonal mandarin oranges, clonal and varietal trials, manurial trials and the establishment of stock seed gardens and of clonal collections. Unfortunately, the execution of these plans had to be postponed because of increasing staff shortages.

550. Big advances were made in the work of establishing central proven-clone budwood nurseries at Serdang and of planting comprehensive clonal collections. Some 6,300 clonal and seedling plants were produced at Serdang, mainly for distribution to State and Settlement Agricultural Officers.

10. FODDERS AND PASTURES

551. The results were studied of an investigation at the Federal Experiment Station, Serdang, in which various imported strains of Napier grass (*Pennisetum purpureum*) and various levels of nitrogenous manuring were compared. The local strain proved superior to all imported ones, and nitrogenous manuring increased yields of cut grass and improved the crude protein content of the grass. Some 43 tons of fresh cut grass per acre per annum were obtained from the local strain, a yield which is higher than those commonly obtained from Guinea grass at Serdang. The detailed results of the investigation are being prepared for publication.

552. The results of past manurial trials with Guinea grass revealed but did not resolve certain important problems. Briefly, these were as follows:

- (a) could economies be effected and yields still further increased, in Guinea grass manuring, by application of both farm-yard manure and artificial fertilisers;
- (b) could the application of both prevent or reduce the marked drop in production of grass from the first to the second years of growth;
- (c) was the previously observed apparent lack of response to phosphate repeated, even when yields were about maximum as a result of other manuring.

A 3³ factorial experiment was designed and laid down to provide information on these matters. It tests combinations of 1, 2 and 3 levels of an NK mixture, and 0, 1 and 2 levels of phosphate and of farm-yard manure.

553. A further trial was designed for the comparison of East African strains of Guinea grass with the local strain. This was not laid down, as planting material was not available in sufficient quantities. Bulking up was begun.

554. One of the limitations of past work with fodder grasses is that the work has not been done on crops growing in integrated farming systems. The reason for this is obvious enough; there are no indigenous farming systems which incorporate cultivated fodder leys, so that there is the need for developing and testing such systems, as well as for the more specific work on the leys themselves, and it has never been practicable to undertake this additional work on a systematic basis. A step in this direction was undertaken at the Melor dry-padi station in Kelantan, however, with an attempt to incorporate a Guinea grass ley into the local system of cattle and padi production. There were grounds for expecting that such might be beneficial in the facts that declining fertility of dry-padi land is sometimes counteracted by substitution of an occasional, tumble-down grazing fallow for the padi crop, and that cattle feed is chronically short in such areas at certain times of year. However, the Guinea grass grew badly and showed little promise in this connection. *Stylosanthes gracilis*, on the other hand, grew very well indeed and may well have considerable value as an alternate ley crop in these areas.

555. A number of species of fodder crops, of which seed were kindly supplied by the Pan-Malayan Scientific Advisory Council, were established in small observation plots. Certain of them show considerable promise.

556. *Brachiaria brizantha* planting material, kindly supplied by the Department of Agriculture, Ceylon, was multiplied and distributed to certain out-stations. It has grown remarkably vigorously and has promise as a grazing and fodder type.

557. An outline plan was made for further work on fodder crops. It was decided that this should concentrate on:

- (a) determination of cattle consumption and growth-rate figures;
- (b) investigation of ways and means of reducing costs of fodder-grass manuring;
- (c) evaluation of fodder legumes and test of degrees and forms of association of these and grasses;
- (d) further comparison of Napier and Guinea grasses.

A start was made on (a) and (b), but staff difficulties prevented the implementation of (c) and (d).

558. An average of 2.6 Kedah-type cattle per acre was maintained in a pasture experiment at the Federal Experiment Station, Serdang; they gained weight at an average rate of 481 lb. per acre over the year.

559. A further amendment was made during the year in the manurial treatments of the NPK factorial trial on *Axonopus compressus* under shade of *Enterolobium saman*. It comprised the substitution of 0, 2 and 4 cwt. of urea per acre per annum for 0, 4 and 8 cwt. of sulphate of ammonia. Yields were generally lower in 1956 than in 1955, the general means being 17.33 and 20.04 tons of fresh cut grass per acre, respectively. The main response was to nitrogen, with a lesser response to potash. No satisfactory method of grazing evaluation of the manurial effects was worked out.

560. An interesting observation was made at the Central Agricultural Station, Ayer Hitam, Johore. The values of Bali and local Kedah type cattle were compared, in grazing utilisation of very rough bush and lalang-infested land. It was found that the Bali cattle were able to live off such land and maintain reasonable condition but that the Kedah animals could not do so. It was also found that grazing of such land by the Bali animals resulted in its gradual conversion into surprisingly good *Axonopus* pasture. This observation suggests a promising possibility for economic rehabilitation of certain of the badly exhausted lalang areas of Johore, where water supplies are available and limited supplementary feed and fertilisers are provided.

11. TOBACCO

561. Lack of staff prevented expansion in investigational work with this crop. Seed production was continued on a small scale at the Federal Experiment Station, Kuala Lumpur. A limited investigation was undertaken of production and processing methods in certain major producing areas in Perak and Kelantan.

12. VEGETABLE AND FOOD CROPS

562. Work continued on a limited scale at the Federal Experiment Stations, Cameron Highlands, Serdang, Kuala Lumpur and Jalan Kebun. An interesting outcome of the work on deep peat at the last-named station is that a wide range of short-term vegetables can be grown successfully on this soil, particularly after burning.

563. At the Federal Experiment Station, Cameron Highlands, the following yields were obtained from three crops grown in rotation in a manurial trial:

YIELDS IN LB. PER 1/25 ACRE (APPROX.)

Crop	Treatments		
	A. 5 tons prawn dust + $\frac{1}{2}$ ton ground limestone per acre per annum	B. 3 tons Sterameal, 238 lb. sulphate of ammonia, 450 lb. double super-phosphate, 100 lb. salt and $\frac{1}{2}$ ton ground limestone per acre per annum	C. 3 tons bean cake plus inorganics as in B plus 312 lb. sulphate of potash and 200 lb. muriate of potash per acre per annum
Cabbage	625.5	365.0	1,156.8
Lobak ..	1,841.3	1,767.0	1,828.3
Beans ..	171.0	540.3	305.8

564. The purpose of the trial was to find a less expensive fertiliser dressing than the traditionally-used prawn dust for

vegetables in the Highlands; as well as its costliness, prawn dust has the serious additional disadvantage of encouraging flies. It will be seen from the results that one or other of the substitute dressings in B and C was more effective than prawn dust for cabbage and beans and as effective for lobak. Both B and C are considerably less expensive than prawn dust.

13. LIVESTOCK

565. Several meetings took place during the year of the Minister's Joint Livestock-Production Committee. Among other things, a framework was agreed upon for future livestock investigations. The main features requiring work by the Department were as follows:

(i) *Cattle*—

- (a) Comparison of the ploughing capacities of Sindhi $\times$ Local and Local Cattle.
- (b) Comparison of the beef-producing capacities of the Bali, Sindhi $\times$ Local and Local breeds of Cattle.

(ii) *Pigs*—

- (c) Field study of the possibility that deficiencies of or unbalances in phosphate and calcium contents of commercial pig rations were responsible for the poor breeding qualities of the cross-bred Middle White $\times$ Local sows.
- (d) Comparison of Middle White and Berkshire boars as sires for the production of half-bred porkers.
- (e) Consideration of the possibilities for selection of superior breeding strains from among the local type of pig.

Work was begun on (a) and (b), but increasing staff shortages prevented the implementation of programmes under the remaining heads.

566. A pig feeding trial was begun at the Federal Experiment Station, Serdang. The feeds under test comprised the normal Serdang meal ration and a modified Lehmann type of ration. The early results suggest that the latter may well be superior to and cheaper than the former.

567. Work was begun in a small-scale test to determine the rates of live-weight increase and of fodder grass consumption of stalled Bali cattle.

C.—EXTENSION AND ADVISORY WORK

1. RUBBER

568. There are about 1.5 million acres of rubber small-holdings in the Federation and the Department co-operates actively with the Smallholders Advisory Service of the Rubber Research Institute of Malaya in order to ensure that growers are kept fully advised of the correct techniques of maintenance, pest

and disease control, anti-erosion measures and the use of fertilisers. Active encouragement is also given in replanting and new planting and in the production of high quality smoked sheet. An effective method of achieving this last result has been to encourage sale of smallholders' rubber latex to centralised commercial or co-operative factories.

569. A major aim of extension has been to provide approved planting material for all smallholders who wish to replant under the Rubber Replanting Scheme and to others who wish to plant new land. This approved planting material takes the form of either Tj. 1 selfed clonal seedlings or budwood of certain recommended clones—namely P.B. 86, Tj. 1, RRI. M501 and M513, G. 1 and PR. 107. The last-named clone is a new addition to Departmental nurseries and there is an increasing demand for it, from inland districts in particular.

570. Clonal seedlings have been produced in all States and Settlements either in contract nurseries owned by small growers or estates or else on Agricultural Stations or nurseries specially acquired by the Department of Agriculture. The planning and supervision of this work has required a great deal of the time of officers of the Field Branch, but a measure of their success has been the fact that all demands for both clonal seedlings and budwood have been met and there has been a small surplus of seedlings and a larger one of budwood.

571. Figures for distribution of improved planting materials in the last five years are given below and these speak for themselves :

DISTRIBUTION OF IMPROVED PLANTING MATERIALS

Year	1952	1953	1954	1955	1956
Budwood (yd.)	46,936	68,105	122,564	190,110	191,883
Clonal seedlings	1,535,715	1,773,388	3,318,643	5,446,689	10,412,173

This planting material was distributed for the following purposes :

	Budwood (yd.)	Clonal seedlings
For new planting	55,070	2,846,560
For replanting	136,813	7,565,613

572. Progress with new planting and replanting by smallholders during the last five years is shown by the following table :

Year	New Planting (acres)	Replanting (acres)
1952	6,800	4,200
1953	6,300	30,520*
1954	3,300	25,740*
1955	8,100	28,900*
1956	not yet available	49,870

573. The production of planting material for future new and replanting by smallholders remains the Department's responsibility, since the Director is Executive Officer of the

* Amended.

Rubber Industry Smallholders Planting Material Scheme, 1956, which was set up in September. Purchases of seed for nurseries during the last four months of 1956 amounted to 13 million Tj. 1 clonal seed and these were distributed and sown in nurseries in all States and Settlements. This total fell far short of requirements, owing to increased exports to other countries.

574. The chief technical difficulty in replanting encountered by smallholders continues to be that of efficient control of lalang (*Imperata cylindrica*).

2. PADI

575. Rice is the staple food of Malaysians and padi the country's most important food crop. Since the amount of land available for expansion is limited, it is all-important that production on land now under padi should be increased and a great deal of the time and energy of officers of the Department is devoted to this major aim of extension work.

576. There are six ways by which yields per acre can be increased; they are:

- (1) by the provision of better irrigation, drainage and water control;
- (2) by the use of improved strains of padi;
- (3) by full use of fertilisers, including the manuring of nurseries;
- (4) by better control of pests and diseases;
- (5) by better agronomic practices, such as the use of high-gravity seed, transplanting seedlings at the correct age and spacing, and regular attention to weed control; and
- (6) by the extension of double-cropping wherever feasible.

577. All these measures have been encouraged by demonstrations and other extension methods on Padi Experiment and Test Stations and also on farmers' lands. However, major improvements of irrigation and drainage are the concern of the Drainage and Irrigation Department, with whose officers the staff of the Department of Agriculture have always had the closest liaison.

578. One very effective method of demonstrating the use of fertilisers has been to lay down demonstration plots on the growers' own lands, and this technique has been used very extensively in 1956 when there were laid down no less than 2,126 manurial demonstrations. These took the form of two-plot blocks with one plot given the recommended manurial treatment and the other left unmanured. Usually, the manurial treatment consisted of a basal dressing of phosphate and potash followed later by a top-dressing of nitrogen. However, in Kelantan and Trengganu an NPK mixture is provided, partly because some nitrogen is required in the basal dressing but also because a mixture is more acceptable than separate fertilisers to farmers in those States.

579. It has in the past been the usual practice to use sulphate of ammonia as the nitrogen top-dressing, but urea is now preferred for three reasons: first, urea is cheaper per unit of nitrogen; secondly, its higher concentration of nitrogen (45 or 46 per cent) means lower freight charges; and thirdly, it is a better fertiliser for the *gelam* soils since these sometimes contain excess sulphur. There has been no delay in making known to padi farmers the value of this excellent new fertiliser and demonstrations in Kedah and Perlis in the 1956-57 season included 153 blocks in which a top-dressing of 30 lb. of nitrogen per acre was applied as granular urea. At all sites except three the treated plots showed a more vigorous and luxuriant growth than the unmanured ones and past experience has shown that on these particular soils a response in yield can be expected from a nitrogen top-dressing. The padi farmer who has to carry his fertiliser requirements along a narrow, muddy path on his shoulder, perhaps for a distance of two or more miles from a road, welcomes a fertiliser which will supply sufficient nitrogen for one acre in 67 lb. of material rather than in 143 lb., as when sulphate of ammonia is used.

580. In some territories, notably in Penang, nursery manuring gives an excellent yield response where Ammophos 11:48 is used at a rate of 2 lb. per gallon of seed. This practice has been demonstrated in both the main and off-seasons and it is gratifying to note that 45 demonstrations laid down in Province Wellesley in the off-season gave responses in yields of grain ranging from 20 to 672 lb. per acre. Since the fertiliser costs only about \$2 per planted acre, manuring in the nurseries is very rewarding. It is effective wherever phosphate normally gives an increase in yield when applied as a field dressing. However, the nursery application of a water-soluble phosphate is relatively much more efficient than a field dressing.

581. The practice of double-cropping is a very efficient method of increasing production of padi and this has always been encouraged in suitable areas. It is important, however, that double-cropping should not develop in an unplanned way, since isolated patches of off-season padi are always subject to severe pest damage. An attempt to introduce double-cropping into Kelantan has failed, but the practice is well-established in Province Wellesley and in smaller areas in Kedah and Malacca. Some 9,010 acres were planted in 1956, of which 8,950 acres were harvested, giving an average yield of 341 gantangs per acre. This is a very satisfactory yield indeed for an off-season crop and compares very favourably with the 1955 yield of 239 gantangs per acre from 6,120 acres harvested.

582. The use of improved strains of padi has been actively encouraged wherever post-war research has produced a significantly better strain. Research is most advanced in this respect in Malacca, where there were some 60 selected-padi seed farms in the 1955-56 season; there were seven much larger farms, totalling 88 acres, in the 1956-57 season. On several of these farms Nachin 5057 has given yields exceeding 700 gantangs per acre, promising much improved crops in the coastal areas of Malacca for which

this variety is particularly suitable. Other varieties grown for extension include Reyong 6 (Rey. 6), Siam 29 (Sm. 29), Serendah Kuning 3 (Ser. Kun. 3) and Radin Siak 34 (R.S. 34).

583. Three seed-farms totalling 20 acres were established in Negri Sembilan in the 1956-57 season. The following varieties were planted: Ser. Kun. 3, 11 and 23, the short-term variety Acheh Puteh and small quantities of *japonica* padi.

584. Pure-strain seed from these farms was made available to cultivators either by direct sale or, more usually, on an exchange basis.

585. The separation of plump, well-filled grain from empty or shrivelled seed can be effected cheaply and simply by a flotation method using brine. The adoption of this method of seed separation in conjunction with improved nursery techniques ensures the production of robust and healthy seedlings capable of resisting attacks by pests and diseases and able to obtain the maximum benefit from manuring.

586. This is now the second year in which staff of the Field Branch have demonstrated and encouraged this method of seed separation and there is evidence that the more progressive farmers are becoming convinced of its effectiveness and are adopting the practice themselves.

587. Economic surveys were continued during the year in Kedah, Perlis and Kelantan. The field work was completed by the end of May and the rest of the year was devoted to the transfer of data onto clip-cards, the analyses of results and the commencement of writing reports.

3. COCONUTS

588. Extension has been confined to the distribution of a modest number of selected seedlings raised from mass-selected parent palms and the dissemination of propaganda on the control of insect pests—particularly the black beetle, *Oryctes rhinoceros*.

4. PINEAPPLES

589. The adoption by smallholders of manuring and other improved practices has been stimulated by the existence of four half-acre cultivation and manurial demonstrations in the Jenjarom area of the Kuala Langat District of Selangor. In this area Departmental staff have helped in the formation of a co-operative marketing society.

590. Five similar demonstration plots have also been maintained at Ayer Hitam, Muar, Johore, and 26 cwt. of a suitable NPK fertiliser have been sold at subsidized rates to small growers in that district.

591. In Lower Perak the smallholders' planting scheme at Kampong Selebak has been held up, largely by problems of drainage.

5. FIBRES

(i) *Jute.*

592. It is now clear that jute cannot compete economically with other off-season crops on the coastal muck soils of Selangor unless retting and hand stripping can be replaced by mechanical decortication. Chinese growers say that growth of the segama variety is superior to what they are accustomed to in China, but the extra labour of retting makes production of the crop uneconomic by comparison with the growing of maize for green cobs.

(ii) *Manila Hemp.*

593. There has been no success in stimulating the cultivation of this crop by small farmers and the price is now much less attractive than in 1951.

6. OTHER CROPS

594. The Rubber Industry Replanting Board has continued to pay a grant for replanting rubber land with certain approved crops and this grant has been increased from \$500 to \$600 per acre. Fruit and coconuts are the most popular alternative crops followed by Liberian coffee, padi, pineapples and sago. Most of the planting materials for these crops came from Departmental sources in order to ensure that the best materials available were used. During the year 3,288 acres of old rubber were replanted with other crops with the aid of grants, bringing the total to 10,860 acres at the end of 1956. In addition, there have been 335 acres of excess replanting with such crops without receipt of a grant.

595. Replanting of old rubber with other crops is permitted only after inspection of the land by Departmental staff has determined that it is suitable for the proposed crop.

7. PLANTING MATERIAL

596. During the year 58,246 budded fruit trees, principally rambutans and durians, were produced and distributed by Departmental nurseries; of these a large proportion were for planting on old rubber land with the aid of grants. It will be appreciated, therefore, that the Rubber Industry Replanting Scheme is proving to be an excellent agency for encouraging the planting up of orchards with clonal fruit.

597. An additional quantity of durian and rambutan budwood, sufficient for budding over 57,500 stocks, has been distributed to commercial nurseries.

598. The following figures indicate how the distribution of budded fruit trees has increased steadily during the last five years:

	1952	1953	1954	1955	1956
Numbers of budded fruit trees distributed ...	16,870	26,781	39,898	50,582	58,246

599. Miscellaneous planting materials distributed included the following:

coffee seedlings	38,286
kapok seedlings	1,500
banana suckers	1,000
derris cuttings	21,340
patchouli cuttings	2,900
guinea grass divisions	2,000
stylo cuttings (bags)	174
maize cobs	1,600
pepper cuttings	190
vegetable seed (lb.)	155

600. Some 16,270 shade trees and ornamental plants have also been distributed, chiefly to Government Departments and to new villages.

8. AMELONADO CACAO SEED GARDENS

601. State and Settlement seed gardens have distributed 2,028 cacao pods for seed and 370 seedlings in addition to the material supplied to estates from Federal Experiment Stations.

602. Departmental staff has continued to keep in close touch with the commercial development of cacao and to give prompt technical aid where required. Commercial cacao cultivation of the West African Amelonado variety is now in progress at the following localities:

Locality	Approximate Acreage Planted, December, 1956
Jerangau Estate, Trengganu	525 acres
Landas Estate, Trengganu	124 "
Smallholders' Pilot Scheme, Trengganu	18 "
Kuala Bernam Estate, Lower Perak	60 "
TOTAL ..	727 "

603. Suitable soil for a second Smallholders' Pilot Scheme is available at two localities in Pahang, but there has been no further development in that State.

9. MECHANISATION

604. A total of 1,080 acres of smallholders' padi land was cultivated by Department of Agriculture tractors during 1956. The usual charge for this service was from \$7.50 to \$8 per hour, but 40 acres were cultivated in Johore at the special subsidized rate of \$15 per acre. In addition, certain commercial contractors have carried out similar work at reasonable prices.

605. Very little dry land has been cultivated on contract by the Department, as in many territories there are now commercial firms specializing in such work. Thus, in Johore, several such firms specialize largely in clearing land for rubber replanting. The charge for felling, burning, de-stumping, ploughing and discing with eradication of *lalang* has been about \$230

per acre. This charge varies somewhat with the degree of *lalang* infestation and the topography and acreage of each unit cleared. All these firms are fully booked up and clearing operations are apparently proving very successful.

606. At the new Coconut Rehabilitation Station at Sungei Sudah, West Johore, a Departmental tractor has been engaged on scrub clearing for a considerable period during the year.

607. In the Dry Padi Scheme at Kampong Akob, Trengganu, a total of 54 acres was cultivated and sown mechanically by the beginning of August.

608. Progress with mechanization in the Dry Padi Scheme at Paya Besar, Pahang, has been disappointing and it was only possible to have 37 acres planted by allowing free use of the Department's tractors and equipment—a concession that cannot be granted again.

609. In Kelantan a mobile padi-straw baler was used to bale straw on Padi Stations and, to a small extent, on cultivators' lands. As a result of this operation the compact bales can be easily transported and stored; this greatly facilitates the use of straw for cattle fodder and litter—and thus the production of pen manure. Many enquiries were received regarding the possibility of hiring such balers in future years.

10. LIVESTOCK

(i) *Pigs.*

610. The popularity of the Middle White cross-bred pig is well established amongst all pig rearers, and breeding centres are maintained throughout the country. During the year, 248 Middle White boars and 220 gilts were distributed to rearers from Departmental sources. In addition, 1,007 services were carried out in new villages and 124 at stud-centres.

611. This great popularity of the cross-bred pig has brought its own problems in that, in certain areas, there has developed a shortage of pure-strain Chinese Black sows so that cross-breeds contain three-quarters or more Middle White blood. This has tended to reduce fertility and steps have been taken to build up a supply of selected Chinese Black animals, of which a superior strain exists in Sitiawan, Perak. This particular problem has been most acute in the Settlements of Penang and Malacca and, in the latter territory, eight Sitiawan Black gilts and two boars have been imported from Perak to form the nucleus of a breeding herd. At the end of the year 17 male and 12 female piglets were being reared.

612. The combination of pig and fish rearing has continued to be an efficient farming practice, whereby pig fodder is grown on the surface of the fish-ponds and the pig manure drains into the ponds and encourages a vigorous growth of fresh-water plankton, on which the fish feed.

(ii) *Poultry.*

613. During the year 1,506 pure-bred cockerels and 1,363 pullets, mostly Rhode Island Reds, were distributed to poultry-keepers throughout the country. In addition, 15,637 eggs for hatching and 91,043 eggs for consumption were sold.

614. The policy of distribution of imported breeds was examined critically during the year in co-operation with the Veterinary Department and it was decided that, in future, emphasis should be placed on upgrading local breeds and on improving feeding and management techniques amongst small-holders in the kampongs. In arriving at this decision it was noted that poultry keeping in the kampong was very much of a sideline, with birds being left to fend for themselves, and that in practice there was little profit in producing large-sized eggs in kampong areas because of the lack of suitable marketing facilities. Nevertheless, it was recognized that there would continue to be a restricted demand for exotic breeds from specialist poultry keepers, particularly those near the larger towns, and that local conditions elsewhere might make it profitable to keep purebred poultry.

615. The Deep Litter or Built-up Litter System of poultry keeping is gaining favour as an intensive method of poultry keeping in urban areas. It is particularly valuable where little land is available and where the farmer is skilled. However, the site should be free from the danger of occasional flooding and the system has little to commend it in the rural areas.

Goats.

616. During the year it was decided that emphasis should be on dual-purpose and meat breeds and all stocks of the milch breeds, Saanens and British Alpines, should be discarded. This has meant that the Department will concentrate on distributing Anglo-Nubian goats until such time as the Veterinary Department has built up a stock of the Indonesian breed. This decision was made because little interest has been shown in milch goats in Malaya and these animals are kept almost exclusively for meat purposes.

617. During the year 21 bucks and nine does were distributed and 39 services were carried out at stud-centres.

11. PESTS

618. An efficient pest-control service is all-important if the improved trend of padi yields is to be maintained. Extensive attacks of army worms, *Spodoptera mauritia*, have been reported from Perlis, Kedah and Penang. Rats are the worst mammalian pest, and although poison-baiting is still the most efficient method of rat control, trapping and the organization of drives are valuable practices. Some 3,520 lb. of zinc phosphide have been distributed for the preparation of poison-baits in addition to those laid by staff of the Department.

619. The efficiency of baiting for the control of rats and bandicoots is indicated by the following statistics from Kedah and Perlis:

Number of baits laid	143,910
Number of baits consumed	92,344
Number of rats killed	66,062
Number of bandicoots killed	5,890
Number of rats and bandicoots killed	71,952

That kills resulted from approximately 50 per cent of the baits laid is considered very satisfactory, especially when the total kill is known to have exceeded the observed number.

620. Throughout the country the following totals of animal pests are known to have been killed:

Rats and bandicoots	137,600
Squirrels	9,925
Monkeys	1,067
Wild pig	1,546
Flying fox, musang, etc.	1,767

621. The padi pest *Nymphula depunctalis* has been of wide-spread occurrence in Trengganu and the black padi bug, *Scotinophora coarctata*, is now widespread over the country as a whole. The latter can be controlled efficiently by the prompt application of DDT and BHC dusts and a total quantity of 1,885 lb. of these materials has been distributed.

622. The green padi bug, *Leptocorisa acuta*, is potentially a very serious pest of padi, particularly in the smaller and more scattered areas. Several outbreaks occurred in Malacca and Kelantan but a build-up of the pest was prevented by prompt treatment with insecticidal fogs generated by portable machines actuated by the pulse-jet principle. In several other territories, also, these machines, owned by the Department, have proved themselves efficient in the control of sudden outbreaks of insect pests on both padi and cacao. Only oil-miscible insecticidal formulations can be used and diesoline has proved to be an effective diluent.

623. In Kelantan, carbide-operated bird-scarers have proved effective in protecting crops from elephants but gave only temporary protection from wild pig.

624. In Johore the activities of the security forces in the forest, coupled with shelling and bombing, have disturbed many of the larger wild animals and consequently there has been damage to crops. Thus, elephants destroyed three acres of smallholders' rubber at Kahang and damaged several acres elsewhere. One rubber tapper was killed by an elephant at Bekok, near Segamat. *Seladang** have damaged many young fruit trees in the settlement area for Ex-Special-Constables at Kampong Mohd. Amin. Deer have been responsible for considerable damage to young rubber in localized areas while tigers have taken several goats and

* *Seladang* = *Bos gaurus*, large wild cattle.

buffaloes in the Triang and Keluang areas. A rubber tapper was killed by a tiger near Kahang and this disrupted tapping on adjacent estates for some time.

625. Attempts to control crabs in the padi fields of north-western Kedah using aldrin and dieldrin formulations killed many fish and water snakes but no dead crabs were observed. Nevertheless, the treatment acted as a deterrent and there was no further damage to padi crops.

12. NEW VILLAGES

626. A considerable amount of extension activity continues to be devoted to the needs of new villages throughout the country. In Selangor special agricultural stations cater particularly for the requirements of Sungei Buloh and Jenjarom villages and similar stations and demonstration plots have been opened up recently at Dabong, Kelantan and near Padang Lembu and Kejai in Kedah. In some instances, the provision of pig stud-services and distribution of planting material and plant protection chemicals are important activities, whereas at Padang Lembu emphasis has been placed on demonstrating recommended methods of establishing clonal rubber after eradication of lalang.

627. In Johore the occupants of new villages have mostly regarded these as house-sites and gain a living from rubber tapping. For security reasons pig-keeping is not permitted outside perimeter fences so the fertility of agricultural land has fallen. To counteract this tendency some 25 tons of NPK fertiliser have been sold by the Department at half-price and additional quantities of fertiliser have been ordered on behalf of villagers. Chaah, Bukit Siput, Bakri and Jementah are four progressive and productive villages and three of them have thriving farmers' co-operative societies. Jementah specializes in the production of Chinese kale, *kai lan*, and exports 400 to 500 pikuls of this vegetable each month.

13. SETTLEMENT SCHEMES

628. Land settlement schemes for ex-Special-Constables have generally proved to be a most unrewarding ground for extension activities. Thus at Kampong Mohd. Amin in Johore much of the land planted with coffee and fruit trees has become overgrown with lalang because of lack of care and interest by the people. A knapsack sprayer and a drum of copper fungicide were offered free to the farmers in an attempt to control coffee rust, but no one was prepared to accept and use this. Similarly, progress in all the schemes in Kedah has been disappointing.

629. At Kampong Jaya Stia in Selangor, the Department maintains a small demonstration station to show the correct methods of planting coffee and pineapples and to supply planting material to settlers. In this instance, development of the housing lots has progressed favourably and at the end of the year 185 families were resident. However, opening up of the four-acre agricultural lots is generally progressing slowly and only some 160 acres have been developed for coffee cultivation.

The chief difficulty here is that settlers are short of capital and are forced to seek outside employment to provide a source of income.

630. Progress under certain other settlement schemes in Selangor is first-class. Thus Bukit Kuching consists of thriving coffee and fruit holdings with tapioca planted as a catch-crop, while Sekinchang produces heavy yields of vegetables in the padi off-season.

631. An aboriginal settlement at Bukit Bangkong near Sepang, Selangor, has received continued attention and some 40 acres have been developed, mainly with Liberian coffee. The standard of maintenance varies considerably between holdings, with several in really excellent condition. Some of this area has been catch-cropped with dry padi and yields were satisfactory.

632. For the new Solok Menggong Scheme in Malacca the Department has prepared a land utilization plan and an estimate of the cost of development. In the same Settlement the Nyalas-Road Malay Model Villages Scheme is being opened up for rubber and some 200 out of 380 acres have been cleared with the help of a subsidy provided by the Minister for Local Government. Planting material and fertilisers are being supplied by this Department.

14. RURAL AGRICULTURAL TRAINING

(i) *Courses at Agricultural Stations.*

633. During the year new Rural Training Centres were completed at Kota Bahru, Kelantan, Bukit Temiang, Perlis, Ayer Hitam, Johore and Sungei Udang, Malacca, bringing the total up to nine. Altogether, 845 trainees received instruction during the year in courses varying in duration from one week to six months. The subjects covered included rubber replanting, fruit propagation and planting, poultry and goat rearing, control of pests and diseases, foodcrop production and the correct use of fertilisers. In many cases, trainees were chosen from one locality per course in order to facilitate the future follow-up in extension work.

634. A measure of the success and popularity of these courses can be gauged from the fact that the new centre at Kota Bahru, which was opened only in July, had a waiting list at the end of the year almost sufficient to fill all vacancies in 1957.

(ii) *Civics Courses.*

635. The Department has contributed to the running of these excellent courses by providing lecturers at many centres throughout the country. Numerous practical demonstrations have also been given on the work of the Department. It is an undoubted fact that these courses form an efficient means of adult education for the rural population.

(iii) *Lectures and Talks.*

636. Numerous lectures have been given by members of the Department to organized parties of visitors to Agricultural Stations and also wherever farmers congregate together—at

mosques, new village community halls, *penghulus** meetings, schools, rural council meetings and elsewhere. A number of radio talks on agricultural subjects have also been given.

637. At one field day at Gelugor Padi Test Station in Trengganu, a short talk on the function of the station was given to a party of padi farmers who had petitioned the Government against expansion of an irrigation scheme. As a direct result of this visit, during which they saw the benefits of the irrigation supply at the station, the farmers changed their minds and the petition was withdrawn.

(iv) *Agricultural Shows and Padi Competitions.*

638. During the year agricultural shows were held in Malacca, Segamat, Muar, Johore Bharu and Jelebu. The Department put up a large educational display at the Malayan Agri-Horticultural Association (M.A.H.A.) Exhibition in Kuala Lumpur.

639. District padi competitions were held in most padi areas, followed by State and Settlement competitions. The best exhibits from these were forwarded to Kuala Lumpur for competing in the All-Malaya Padi Competitions which were held in conjunction with the M.A.H.A. Exhibition. Padi planting competitions were also organized in some areas.

(v) *Agricultural Newsletters.*

640. Agricultural newsletters of topical and local interest were published and issued free in eight States and Settlements. Altogether, 12 separate issues were printed in Malay and one in Chinese. The number of copies of each newsletter varied, but in Kelantan and Penang 10,000 copies of each issue in Malay were printed and distributed. There is no doubt that these newsletters provide a most effective means of Departmental contact with the rural population.

(vi) *Farmers' Register.*

641. In the Kuala Langat district of Selangor an interesting and valuable aid to extension has evolved from a farmers' register. Originally this card index of contacts between farmers and Agricultural Assistants was made with four objects:

- (a) to achieve continuity of extension work, even where an Agricultural Assistant might be transferred with little time allowed for a orderly hand-over to his successor;
- (b) to provide an "after-sales-service" to farmers who purchased planting material from the Department or who requested advice on some subject;
- (c) to record information on the progress and achievements of extension work; and
- (d) to facilitate supervision of extension work.

642. At first, all contacts were registered in a card index but this was found to be wasteful of effort as not all of these

* *Penghulu* = head man of small district or village.

could be followed up efficiently nor, indeed, did all of them justify this attention. Later on, therefore, only those men were registered who ordered an appreciable quantity of planting material or who seemed to be particularly keen.

643. In the first year of the scheme 66 farmers were registered and these have been classified as follows:

11—failures;

19—progress insufficient to justify intensive effort; and

36—progressive farmers.

644. Attention was then concentrated on paying regular visits to these progressive farmers, arranging short courses for them or organizing visits to agricultural stations or to farms owned by members of the group. Each such visit or event was registered on the back of the card, the front side having been used to record such details as the farmer's name, address, particular interests, purchases of planting material or eggs for setting and the soil type of his farm.

645. This policy of concentrating on a few selected farmers has paid dividends, since these men have become effective unpaid extension-workers and their holdings form useful demonstrations of the results of the use of improved techniques. Furthermore, these farmers form an effective link between the Department and the mass of village people.

646. This register has also enabled the extension worker to plan his work effectively and to avoid wasting time on unprofitable visits. It will also be of great value in planning more extensive propaganda when the number of extension workers in the field is increased.

D.—AGRICULTURAL EDUCATION

1. ADVISORY COUNCIL

647. The Advisory Council met once during the year, on the 23rd January. There were no changes in the membership of the Council, which is as follows:

The Director of Agriculture, Federation of Malaya
(*Chairman*)

The Director, Veterinary Services, Federation of Malaya
The Principal, Sultan Idris Training College, Tanjong
Malim

The Principal, College of Agriculture, Malaya

The Director, Rubber Research Institute of Malaya

The Hon'ble Mr. H. A. Campbell, C.B.E., Representative
of the Rubber Producers' Council of the Federation of
Malaya

Mr. Gunn Lay Teik, O.B.E.

The Hon'ble Enche Hashim bin Awang, J.P.

Dato' Jaffar bin Mampak, O.B.E.

Enche Jamaludin bin Aji
 Enche Senu bin Abdul Rahman
 The Hon'ble Mr. Yap Kim Hock
 Secretary of the Alumni Association, College of Agriculture, Malaya
 The Registrar and Bursar, College of Agriculture
 (Secretary).

2. COLLEGE YEAR

648. The year was divided into three terms, as follows:
 3rd term, 1955-56 session—11th January to 12th April;
 1st term, 1956-57 session—13th June to 7th September;
 2nd term, 1956-57 session—2nd October to 18th December.

3. REGISTER OF STUDENTS

649. The numbers of students in training were as follows:

REGISTER OF STUDENTS, JUNE, 1956					
Category	Malays	Chinese	Indians	Others	Total
DIPLOMA COURSE					
THIRD YEAR STUDENTS (1954-57)					
Federal Scholars	5	9	2	—	16
Private Students, Federal	—	2	—	—	2
Negri Sembilan State Scholar	1	—	—	—	1
Singapore Scholar	—	1	—	—	1
	6	12	2	—	20
SECOND YEAR STUDENTS (1955-58)					
Federal Scholars	10	4	—	—	14
Private Students, Federal	—	2	—	—	2
Rubber Research Institute Students in Training	1	2	—	—	3
Singapore Scholar	—	1	—	—	1
	11	9	—	—	20
FIRST YEAR STUDENTS (1956-59)					
Federal Scholars	9	5	—	—	14
Junior Agricultural Assistant Major Scholar, Agronomy Branch	1	—	—	—	1
Rubber Research Institute Student in Training	—	1	—	—	1
Singapore Scholar	—	1	—	—	1
North Borneo Students in Training	—	3	—	—	3
	10	10	—	—	20
MINOR COURSE (1956-57)					
Probationer Junior Agricultural Assistants in Training	27	—	—	—	27
Malay School Teacher in Training, Kelantan	1	—	—	—	1
Brunei Students in Training	2	—	—	—	2
	30	—	—	—	30
GRAND TOTAL ..	57	31	2	—	90

4. TRAINING

650. The training in the Diploma Course followed, in general, the same lines as before. The nurseries specially designed for training in budgrafting and marcotting techniques were enlarged and practical training in rubber tapping and processing was also expanded. Students have received, as in previous years, practical training in horticultural techniques and in pruning of cacao and fruit trees by the staff of the Federal Experiment Station, Serdang.

651. Instructional visits for training in tea production were made to Cameron Highlands and for training in pineapple and coconut production to the Klang and Kuala Langat Districts of Selangor. The help of estates in this training was of great assistance. Visits were also made to Malacca for training in the cultivation and harvesting of padi. Increasing emphasis has been given to the economic aspects of the production of agricultural produce.

5. HEALTH AND RECREATION

652. The health of the students and labour force was good. There were no cases of serious illness.

6. CATERING

653. This has remained a staff responsibility.

7. ALUMNI ASSOCIATION OF THE COLLEGE OF AGRICULTURE

654. The Alumni Association is very active and its contributions are growing in importance.

8. GENERAL

655. The college celebrated its Silver Jubilee on the 14th April, 1956.

656. A Staff Refresher Course for Agricultural Assistants was held at the College from the 21st to the 25th May, and from the 4th to the 8th June.

E.—PUBLICATIONS AND LIBRARY

1. PUBLICATIONS

657. The Department's principal publications are the *Malayan Agricultural Journal* and technical bulletins.

658. Three issues of the *Journal* were published during the year; they were Vol. 38, No. 4, and Vol. 39, No. 1 (with index) and No. 2. A revised Classified Index to the *Malayan Agricultural Journal* (covering the period 1912 to 1954) was published in January.

659. During the year, the Publications Committee decided that future issues of special bulletins should be made in one series, the new series to commence with Bulletin No. 101. The last bulletins to be issued in the series discontinued were: Scientific Series, No. 26; General Series, No. 32; Economic Series, No. 15; and Mechanisation Series, No. 1. The only bulletin to be issued during the year was Bulletin No. 101, "Pot Experiments on the Insecticidal Control of Padi Stem-Borers".

660. The following leaflets were published during the year:

In English—

Poultry Leaflets Nos. 2 and 4, "The Housing of Poultry" and "The Choice of Stock".

Agricultural Series No. 9 (Revised), "Pepper".

Agricultural Series No. 30 (Reprinted), "Fermentation and Drying of Cacao Beans".

Agricultural Series No. 32, "The Establishment and Maintenance of Fruit Trees".

Agricultural Series No. 34, "Oil Palm".

In Chinese—

Poultry Leaflets Nos. 2 and 4, "The Housing of Poultry" and "The Choice of Stock".

In Malay—

Agricultural Leaflet No. 40, "Cacao".

Material was prepared for publication in early 1957 of the following leaflets in Chinese and Malay: "Pepper" and "The Establishment and Maintenance of Fruit Trees".

661. Pamphlets describing the Department's exhibit at the Malayan Agri-Horticultural Association Exhibition were published in English, Malay and Chinese. In addition, a pamphlet dealing with the Plant Import Regulations of the Federation of Malaya was published in December.

662. Translation to English of the Chinese publication "Pineapples in Taiwan" was completed during the year. The translated text was 200 pages in length.

663. A number of short articles were written and translated for the Chinese newspaper "Farmers' News", a publication issued by the Department of Information Services.

664. Government's inability to recruit a Malay Writer and Translator for the Department handicapped efforts to produce material in that language.

665. The following summary shows which publications were printed during the year, together with the number of copies sold or issued free:

IN ENGLISH	Sales	Free and Exchange	Total
MALAYAN AGRICULTURAL JOURNAL—			
Vol. 38, No. 4	490	679	1,169
Vol. 39, No. 1	447	682	1,129
Vol. 39, No. 2	418	673	1,091
			3,389

BULLETINS (Printed)—			
No. 101, "Pot Experiments on the Insecticidal Control of Padi Stem-Borers" ..	19	212	231

LEAFLETS (Printed)—			
Agricultural Leaflet No. 32. "The Establishment and Maintenance of Fruit Trees" ..	—	874	874
Agricultural Leaflet No. 34. "The Oil Palm" ..	—	545	545
Poultry Leaflet No. 2. The Housing of Poultry" ..	—	2,802	2,802
Poultry Leaflet No. 4. "The Choice of Stock" ..	—	2,748	2,748
Agricultural Leaflet No. 9 (Revised). "Pepper" ..	—	550	550
Agricultural Leaflet No. 30 (Reprinted). "Fermentation and Drying of Cacao Beans" ..	—	29	29

IN MALAY

LEAFLETS—				
Agricultural Leaflet No. 40, "Cacao" ..	—	1,400	1,400	

IN CHINESE

LEAFLETS—		Sale	Free and Exchange	Total
Poultry Leaflet No. 2. "The Housing of Poultry"	—	3,268	3,268	
Poultry Leaflet No. 4. "The Choice of Stock"	—	3,268	3,268	
Agricultural Leaflet No. 10. "Cacao"	—	1,028	1,028	

666. The following summary shows the number of back issues of the various publications of the Department which were distributed during 1956:

	Sales	Free and Exchange	Total
<i>Malayan Agricultural Journal</i>	2,108	152	2,260
Malayan Planting Manual No. 2, <i>An Outline of Malayan Agriculture</i>	55	—	55
Special Bulletins	179	212	391
Agricultural Leaflets	—	478	478
Poultry Leaflets	—	560	560
Grow-More-Food and Educational Series (discontinued)	—	145	145
<i>Malay Agricultural Journal</i> (discontinued) ..	—	26	26
Leaflets in Malay	—	427	427
Chinese Agricultural Journal (discontinued) ..	—	78	78
Leaflets in Chinese	—	336	336
Tamil Agricultural Journal (discontinued) ..	—	84	84
Leaflets in Tamil	—	12	12
			4,852

667. The following is a summary of the numbers of publications sold and distributed during the year:

					Sales	Free and Exchange	Total
English	..	..	..	..	3,716	11,341	15,057
Malay	..	..	..	..	—	1,853	1,853
Chinese	..	..	..	..	—	7,978	7,978
Tamil ..	..	..	..	..	—	96	96
					<u>3,716</u>	<u>21,268</u>	<u>24,984</u>

668. Comparative figures for total revenue received during 1955 and 1956 from the sale of publications and from advertisements are as follows:

				1955		1956
				\$	c.	\$ c.
Sale of publications	..	..	..	5,052.80	..	5,116.47
Advertisements	..	..	..	1,686.25	..	1,987.84
				<u>6,739.05</u>		<u>7,104.31</u>

2. LIBRARY

669. The Library contains about 3,850 books and reports published in book-form and nearly 29,750 volumes of periodicals. There are approximately 1,050 unbound volumes of periodicals which are of earlier years and incomplete. The Library also contains many thousands of pamphlets and reprints. Approximately 1,350 periodicals are available.

670. Over 150 periodicals and all annual reports are circulated to members of the staff as they are received.

671. Additional book-cases purchased during the year provided 112 ft. of book-space and relieved some of the congestion in the section housing periodicals. Certain sets of the periodicals were reclassified for easier reference.

F.—SCHEMES SPONSORED UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACT (U.K.)

1. SCHEME D. 2115

672. A grant of £35,000 (\$300,000) was approved for the purpose of research and development work directed at establishing a cacao industry in Malaya. The scheme is designed to cover the period 1st January, 1954, to 31st December, 1956.

673. Investigations on cacao cultivation commenced in 1949 and much progress has been made, but these investigations have not yet reached the stage when conclusive recommendations can be made, and there is, therefore, a pressing need to continue research, particularly on cultivation techniques. Expenditure in 1956 was \$103,231.08.

2. SCHEME D. 2203

674. A grant of £15,658 (\$134,211) was approved for a survey and investigation into the economics of padi production. The purpose of this investigation is to obtain an accurate assessment of the padi cultivator's true cost-of-production and to investigate certain other problems which are believed or known to affect production. In addition, the survey will provide the basic information on the various factors upon which a sound policy for expanding rice production can be based. This scheme commenced in 1954 and is due to end on the 31st March, 1957. Expenditure in 1956 was \$44,503.

3. SCHEME D. 2225

675. A grant of £31,900 (\$273,428.57) was approved for investigations into mechanisation of rice cultivation. The scheme is designed to assess the possibilities of mechanisation as an aid to padi cultivation by the smallholder. A pilot mechanisation scheme of 50 acres has been established in an area where, through the construction of drainage and irrigation works, a considerable amount of new land can be opened up for padi cultivation. The aim is to discover whether, with the aid of complete or partial mechanisation, a cultivator can plant a considerably larger acreage than he does at present, thereby (a) producing a greater amount of padi in excess of his own needs and (b) raising his standard of living. This scheme closed on the 31st December, 1956, but will be extended for one year. Expenditure in 1956 was \$116,958.68.

4. SCHEME R. 747

676. A research grant of £50,500 (\$432,857.14) was approved for the establishment of an experiment station on which field investigations into the effects of various types of water control on the growth and yield of padi would be carried out. This scheme, designed to provide more information on the function of water in rice cultivation, should enable improvements to be made in the design of drainage and irrigation schemes and lead to a material increase in rice production. This scheme, administered in close co-operation with the Department of Drainage and Irrigation, commenced in 1956 and will terminate in 1960. No expenditure was incurred in 1956.

SECTION V

AGRICULTURAL LEGISLATION

1.—RUBBER INDUSTRY (REPLANTING) (SMALLHOLDERS) SCHEME

677. This scheme, which has been approved by the High Commissioner in Council, is for the benefit of smallholders (Legal Notification 119 of the 5th April, 1956, refers).

2.—RUBBER INDUSTRY (SMALLHOLDERS ASSOCIATIONS)
SCHEME, 1956

678. This scheme is for the benefit of smallholders and to assist the Council of Malayan Smallholders' Associations to further its aims (Legal Notification 306 of the 27th September, 1956, refers).

3.—OPEN GENERAL LICENCE (EXPORTS), 1956

679. The exportation to any destination of the goods described is hereby authorised: guano, sago, padi, rice, etc. (Legal Notification 410 of the 13th December, 1956, refers).

4.—TOBACCO (LICENSING) ORDINANCE, 1954

680. An amendment ordinance has been passed to impose duty on raw and leaf tobacco grown in the Federation (Federation of Malaya Ordinance No. 57/56 refers).

R. G. HEATH,
Director of Agriculture,
Federation of Malaya

APPENDIX I

AREAS UNDER VARIOUS AGRICULTURAL CROPS

Federation of Malaya

	1951 Acres	1952 Acres	1953 Acres	1954 Acres	1955 Acres	1956 Acres
RUBBER:						
Estates	1,964,000	1,997,000	2,030,000	2,018,000	2,015,000	2,008,000
Smallholdings	1,500,000*	1,500,000*	1,500,000*	1,500,000*	1,500,000*	1,500,000*
Oil Palm	97,377	100,182	108,265	109,000	111,000	115,183
Coconut	509,306	512,967	512,744	494,000	495,000	517,060
Padi (Rice)	875,390	831,050	834,010	845,990	891,090	875,880
Total	4,982,073†	4,944,199†	4,955,019†	4,948,990†	4,997,090†	5,008,123†
FOOD CROPS:						
Tapioca	27,411	23,428	28,183	30,947	31,244	36,344
Sweet Potato	10,843	13,449	16,735	19,274	19,394	19,183
Sago	6,467	6,364	6,826	6,954	7,080	6,821
Sugar Cane	2,055	1,861	2,008	2,050	2,022	1,991
Groundnut	1,943	2,479	2,485	2,785	3,311	2,880
Maize	2,997	7,332	4,224	8,849	6,744	6,173
Yam	1,077	1,101	1,099	1,436	1,704	1,579
Colocasia	3,072	3,390	3,404	3,278	3,439	3,528
Ragi	39	25	111	158	101	84
Soya Bean	106	117	152	223	194	137
Pulses	784	1,569	1,945	1,556	1,415	836
Vegetables (Market Gardens)	10,671	12,640	14,910	18,106	20,204	22,174
Total	67,465	73,755	82,082	95,616	96,852	101,730
FRUITS:						
Pineapple	24,468	24,843	23,930	27,949	34,848	44,777
Banana	39,988	40,257	48,508	56,384	56,831	60,545
Papaya	452	478	568	749	777	862
Cashew Nut	2,102	2,120	2,105	2,134	2,083	2,166
Durian	25,270	26,652	27,394	28,301	31,040	31,919
Rambutan	14,779	15,848	17,951	17,850	18,802	19,418
Mangosteen	7,342	8,025	8,561	8,588	8,408	8,350
Citrus Fruits	2,064	2,312	2,854	3,387	5,081	5,837
Mango	2,099	2,386	2,594	2,468	2,572	2,497
Chiku	1,838	2,014	2,001	1,995	1,900	2,009
Duku	3,279	3,436	3,775	3,806	3,777	3,782
Rambai	2,129	2,460	2,499	2,517	2,492	2,418
Chempedak	2,767	3,061	3,187	3,160	3,494	3,473
Jack Fruit	1,148	1,404	1,572	1,559	1,443	1,553
Other Fruits	31,036	28,880	26,118	26,090	22,468	24,612
Total	160,761	164,176	173,617	186,937	196,016	214,218
SPICES:						
Arecanut	47,659	44,862	46,300	45,417	40,303	42,974
Chillies	2,212	3,258	3,768	4,159	4,478	4,394
Pepper	156	204	377	678	676	724
Ginger	976	1,013	974	1,263	1,344	1,498
Sireh	2,729	2,900	2,983	3,100	2,967	2,653
Nutmeg	80	59	55	54	82	71
Cloves	226	195	183	176	175	188
Turmeric	838	731	959	1,097	1,088	1,086
Total	54,876	53,222	55,599	55,944	51,113	53,588
MISCELLANEOUS:						
Tea	8,497	8,561	8,719	9,000	9,000	8,719
Coffee	7,435	9,299	9,286	10,557	12,603	13,078
Cacao	531	295	302	418	655	946
Tobacco	2,109	3,830	2,579	4,489	4,200	4,018
Derris	428	244	426	463	512	684
Nipah	33,472	33,749	34,105	34,425	34,878	33,339
Gambier	831	932	908	910	775	716
Kapok	1,567	1,411	1,675	1,579	1,575	1,531
Ipecacuanha	179	250	143	143	140	10
Patchouli	16	8	37	81	83	26
Citronella	19	27	29	30	21	17
Gutta Percha	5,635	5,635	5,635	5,471	4,642	4,642
Other Miscellaneous	1,213	1,437	1,448	1,494	1,376	2,054
Total	61,932	65,678	65,292	69,060	70,460	69,780
TOTAL ALL CROPS	5,327,107†	5,301,030†	5,331,609†	5,356,547†	5,411,531†	5,447,440†

* Estimated figure only, as no accurate figures are available for smallholding acreages of rubber.

† For calculating total acreages, an estimate of 3,500,000 acres for the area under rubber on estates and smallholdings is used for each year.

